
BIBLIOTHECA BODLEIANA

MULE-SPINNING-ROOM.—SPINNER AND PIECER AT WORK.

THE

HAND BOOK

OF

SILK, COTTON, AND WOOLLEN MANUFACTURES.

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PREFACE

THE object of this work is to teach neither spinning nor weaving; its design is to furnish general readers with the history of those manufactures which have been raised to unparalleled eminence by British skill and industry; to mark the causes by which their progress was accelerated or retarded; to point out to the curious the ingenuity of the mechanical processes by which labour is abridged and fatigue prevented; to excite the sympathy of the philanthropic in the condition of those who largely contribute to the general welfare of the community; and to show to the patriotic the vast importance of these manufactures in upholding the rank which Britain has gained amongst nations. Having contributed the history of the cotton-manufacture to the description of the County of Lancashire, which forms part of "England in the Nineteenth Century," I have to thank the proprietors for permission to copy my descriptions of the most important processes into the present work. I could not describe them better than I did then, and I should have regretted describing them worse. Those, however, who wish to connect the study of manufacturing processes with a knowledge of the localities in which they are conducted, must turn to the Northern Division of England in the Nineteenth Century, in which the most available and latest information on these topics will be found.

It was no part of my purpose to discuss the moral results of machinery and manufactures; first, because such a discussion might have led to controversy, and secondly, because my views on the subject have been already laid before the public in my "Notes of a Tour in the Manufacturing Districts." It was of course impossible to write the history of any branch of industry without some reference to the principles of economic science, particularly such as relate to the remuneration of those engaged in industrial pursuits. On these points I have endeavoured to be as brief as I could possibly be without becoming unintelligible, and in no case have I put forward any theories of demand and supply which are not recognised on all hands as incontrovertible truths.

My great aim has been to render what may be called the literature of manufactures interesting as well as instructive. It may be said that I have devoted too much space to the elucidation of the ancient history of the textile arts, and the references made to the subject in the Bible; but I trust that this will be pardoned, and that every attempt, however humble, to elucidate the narratives and confirm the historical verity of the Sacred Records, will prove acceptable to a Christian community.

W. C. T.

Arlington Street, Camden Town,
Dec. 30, 1842.

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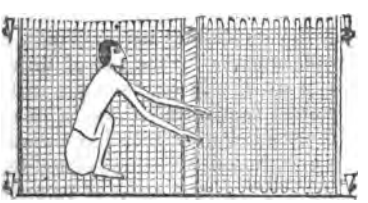


CHAPTER I.

EARLY HISTORY OF SPINNING AND WEAVING.

THE art of weaving is, undoubtedly, more ancient than that of spinning, and was, probably, invented in the very earliest stages of society. When men passed from the condition of hunters to that of shepherds or agriculturists, they must soon have discovered that the skins

of animals did not afford sufficient materials for clothing, and were, besides, too heavy for a warm climate. Under such circumstances, many would, probably, have recourse to the expedient adopted by our first parents, and make a covering of leaves by twisting the stems together, a process which in the Book of Genesis has been rather inaccurately rendered "sewing the fig-leaves." An obvious improvement on the garment of leaves, and one very likely to be suggested by the process of twisting the leaf-stems, would be the interlacing of strips of bark, or ribbon-shaped leaves, in the form of a mat. Communities still exist in the Pacific Ocean and the interior of Africa with whom invention has yet gone no further than the preparation of matting from strips of bark, straw, and rushes. These are manufactured in a horizontal loom, not very unlike that used by the ancient Egyptians, a representation of which, copied from the monuments, is given at the head of this chapter. It could not have escaped the notice of the mat-weavers, that their work was rendered more flexible and agreeable to the wearers by the use of finer fibre, and trials would, in all likelihood, be made with the fibres of various plants, particularly those of the hemp and flax tribe. Experience must soon have shown, that the fibres were strengthened by being twisted together, and thus the art of weaving by a series of processes not very difficult to be traced became the parent of the art of spinning.

From sacred and profane history we learn, that the cultivation of flax formed an important branch of national industry in Egypt, from times beyond the memory of man. It is first mentioned in the description of the Plagues by which the Egyptians were coerced into permitting the departure of the Israelites. Both the flax and the barley-crops suffered in the plague of hail, "for the barley was in the ear and the flax was bolled;" we may remark, that this incidentally enables us to fix the season of the year in which the plagues were in-

flicted, for flax in Egypt begins "to boll," or throw up its long shoots, about the beginning of February.

The transition from vegetable fibre to the use of animal staples, such as wool and hair, could not have been very difficult; indeed, it took place at a period of which we possess no written record. It is, however, mentioned by Moses as a very honourable art, and the spinning required for the use of the tabernacle conferred some distinction on those who were engaged in that occupation. "All the women that were wise-hearted did spin with their hands, and brought that which they had spun, both of blue, and of purple, and of scarlet, and of fine linen." (Exod. xxxv. 25.) The sacred historian also mentions a material for spinning which has not been positively identified on any of the Egyptian monuments, though, in some instances, its presence may be plausibly conjectured; "all the women whose hearts stirred them up in wisdom spun goats' hair." (Exod, xxxv. 26.)

The ancient spindle or distaff was a very simple instrument. The late Lady Calcott informs us, that it continued even to our own days to be used by the Hindoos in all its primitive simplicity. "I have seen," she says, "the rock or distaff formed simply of the leading shoot of some young tree, carefully peeled, it might be birch or elder, and, further north, of fir or pine; and the spindle formed of the beautiful shrub Euonymus, or Spindle-tree. This primitive mode of spinning first gave way to the spinning-wheel before it finally disappeared in the invention of more complicated machinery, though the spinning-wheel is far from obsolete."

Spinning among the Egyptians, as among our ancestors of no very distant age, was a domestic occupation in which ladies of rank did not hesitate to engage. The term "spinster" is yet applied to unmarried ladies of every rank, and there are persons yet alive who remember to have seen the spinning wheel an ordinary piece of furniture in domestic economy. On the Egyptian mo-

numents illustrative of the private life of that extraordinary people, we find the lady of the mansion superintending the labours of her servants and sometimes using the distaff herself. Her spindle made of some precious material, beautifully ornamented, her splendid work-basket, or, rather vase, and the wool dyed of some bright hue to render it worthy of being touched by aristocratic fingers, remind us of the appropriate present which the Egyptian queen, Alcandra, made to the Spartan Helen; for the beauty of that frail fair one is scarcely less celebrated than her skill in embroidery and every species of ornamental work. After Polybus had given his presents to Menelaus, who stopped in Egypt on his return from Troy,

> Alcandra, consort of his high command,
> A golden distaff gave to Helen's hand;
> And that rich vase with living sculpture wrought,
> Which heap'd with wool the beauteous Philo brought;
> The silken fleece, empurpled for the loom,
> Rivall'd the hyacinth in vernal bloom.—*Odyssey*, iv.

Some commentators have suggested that Abraham brought his Egyptian slave Hagar to Canaan, on account of her skill in spinning, believing that this branch of industry was not known in ancient times beyond the

limits of the Valley of the Nile. But we find from the book of Joshua, that flax was very anciently cultivated in Palestine, for Rahab, the harlot of Jericho, concealed the spies under the stalks of flax which she had laid to dry on the house top. Spinning and weaving were also practised in Idumea, the latter forming the subject of a beautiful allusion in the Book of Job:

> My days are slighter than the weaver's yarn;
> They are finished like the breaking of a thread.
> *Job* vii. 6.—*Wemyss's Trans.*

There is the same image in Hezekiah's complaint, a passage, by the way, which has sadly perplexed commentators, but is at once explained by the custom of the weaver's cutting away the thrums by which the piece is fastened in the loom, when his work is completed:

> My life is cut off as by the weaver,
> He will sever me from the loom;
> In the course of the day thou wilt finish my web.
> *Isaiah* xxxviii. 12.—*Lowth's Trans.*

From the history of Samson it is evident, that the cultivation of flax and the arts of spinning and weaving were practised by the Philistines. But the Hebrews were essentially an agricultural and pastoral people, equally averse to commerce and manufacturing industry. Solomon exerted himself to reform the national habits; he established an emporium at Eziongeber to open trading communications with the eastern seas, while his connexion with the Tyrians enabled him to participate in the commerce of the Mediterranean. It appears that he wished to make textile fabrics one part of his exports, by his entering into a league with the reigning Pharaoh to receive linen-yarn at a stipulated price, or, as the words may be rendered, at a fixed duty. This early example of a commercial treaty for regulating a tariff of intercourse, is curiously illustrated by the recent discoveries in Egyptian antiquities; we find from them, that the Pharaohs had very large spinning establishments, such

as we should in the present day call factories, so that there was not only enough of yarn left for home consumption in the valley of the Nile but also for exportation. Had Solomon resembled some modern statesmen he would have protected the spinning industry of Judæa by laying a prohibitory duty on the import of foreign yarns; but Solomon was aware that the protection to Hebrew flax-growers and spinners would so enhance the price of yarn to Hebrew weavers, that they could not bring their goods into a foreign market. He did not establish a monopoly, for he saw very clearly that every monopoly is a great injury to the many for the small benefit of the few, and instead of telling his weavers to look exclusively to the home-market, he endeavoured to open for them as many foreign markets as possible.

The horizontal loom delineated at the head of this chapter is the earliest and most simple form of weaving-machinery. The representation of it was found by Menutoli on the tombs of Beni Hassan; its construction may be understood from the following description. The frame-work is held fast by four blocks securely embedded in the ground; the workman sits on that part of the web already finished, which is, in the original painting, a small delicately chequered pattern of yellow and green; the materials spread around prove, that the yarn was died in the wool before it was placed in the hands of the weaver. The horizontal loom was obviously derived from the more ancient process of mat-weaving: it appears to have been chiefly applied to the manufacture of plaids or chequers, the patterns for which were most probably suggested by the interlacings of bark or strips of broad-leaved plants. Indeed, the modern plaids so obviously represent this origin of their patterns, that no one can for a moment doubt concerning the source from which they were derived. The process of weaving in the horizontal loom must have been both tedious and expensive, particularly as the artisans do not appear to have been acquainted with any instrument analogous to

the shuttle; some drew the weft through with their fingers, and others used an implement somewhat like a knitting-needle with a hook at the end of it. Homer incidentally mentions the spool or spindle on which the weft-yarn was wound, in his description of the race at the funeral-games in honour of Patroclus:

> Oileus led the race;
> The next Ulysses, measuring pace with pace
> Behind him, diligently close he sped,
> As closely following as the running thread
> The spindle follows, and displays the charms
> Of the fair spinner's breast, and moving arms.—*Iliad*, xxiii.

He does not, however, mention the shuttle, nor is it likely to have been invented so early as the age of the Trojan war. Virgil may therefore be suspected of anachronism in the account which he gives of the effect produced on the mother of Euryalus by the intelligence of her son's death:

> The vital warmth her trembling limbs forsook;
> She dropp'd the shuttle and with horrour shook.—*Æneid*, ix.

The shuttle was, however, familiarly known in the classical ages; it was made of box, brought from the shores of the Euxine, and pointed at both ends, that it might easily force its way through the warp. Ovid describes the very ungallant use to which Minerva applied this implement in her contest with Arachne:

> A boxen shuttle in her hand she took,
> And more than once Arachne's forehead struck;
> The unhappy maid, impatient of the wrong,
> Down from a beam her injured person hung.—*Metam.* iv,

The horizontal loom was always used by male operatives, and hence Herodotus declares, that weaving in Egypt was only practised by men. His assertion must

be limited to the weaving of cloths for public sale; we shall soon see that those used for domestic consumption were woven by the females of the families, both the ladies and the servants. It is obvious that, with such a piece of machinery as the Egyptian horizontal loom and the use of several colours in the chequer, to produce such rich effects as those of the variegated Scottish plaids, must have been very laborious, though clearly not impossible. We may also reasonably conclude that those "plaids of many colours," would be highly valued in patriarchal ages, especially as dresses have been always regarded in the East as symbols of rank and distinction. Hence we may explain the cause of jealousy to which Joseph was exposed when Jacob presented him with a dress superior to those worn by his brethren. The sacred historian relates, "Now Israel loved Joseph more than all his children, because he was the son of his old age; and he made him a coat of many colours. And when his brethren saw, that their father loved him more than all his brethren, they hated him, and could not speak peacefully unto him." (Gen. xxxvii. 3, 4.) Their envy was excited not only by the superior beauty of his dress, but by his father's having apparently invested him with some special dignity or authority over his brethren, of which the ornamented garment was the outward sign. Even at this day Eastern potentates, when they confer office upon a favourite, present him also with a *khelât*, or dress of honour, as a symbol of the rank to which he has been elevated.

The upright loom used by women was simply a strong beam over which the warp was passed; the weft was introduced by the substitute for a shuttle already described, and was then pressed and held in its place by a heavy bar of metal, which in the Book of Judges our translators have rendered by the inappropriate term "pin." Hence we see that Samson displayed considerable strength when he broke the snare of the wily Delilah after having deceived her by a false statement of

the secret on which his strength depended. "Delilah said unto Samson, Hitherto thou hast deceived me and told me lies; tell me wherewith thou mightest be bound. And he said unto her, If thou weavest the seven locks of my head with the web. And she fastened it with the pin (the heavy iron bar already described), and said unto him, The Philistines be upon thee, Samson. And he awaked out of his sleep, and went away with the pin of the beam and with the web." (Judges xvi. 13, 14.) Ovid in his description of the contest between Minerva and Arachne describes pretty accurately the mode in which this loom was prepared for work:

> Straight to their posts appointed both repair,
> And fix their threaded looms with equal care;
> Around the solid beam the web is tied,
> While hollow cones the parting warp divide;
> Through which with nimble flight the shuttles play,
> And for the woof prepare a ready way.—*Metam.* vi.

If we are to judge from the delineations existing on the Egyptian monuments, weaving was not regarded as a very exhila ating employment; in several instances we can see signs of sadness and melancholy on the

countenances of the females employed in the task, reminding us of the sorrowing Penelope:

> Full opposite before the folding gate
> The pensive mother sits in humble state;
> Lowly she sat and with dejected view
> The fleecy threads her wary fingers drew.—*Odyssey*, xvii.

But the sombre aspect of the persons thus engaged is easily explained when we remember, that most of the female operatives engaged in domestic spinning and weaving were captives taken in war, fallen from their former high estate, and forced to bear the contumely of an imperious mistress. It will be remembered with what bitterness of feeling Hector forebodes such a fate for his beloved Andromache:

> Thy woes, Andromache, thy grief I dread,
> I see thee trembling, weeping, captive led;
> In Argive looms our battles to design,
> And woes of which so large a part was thine.—*Iliad*, vi.

If the common tradition be true, that the Bayeux tapestry, which records the principal events of the Norman conquest, was worked by Saxon ladies at the command of William the Conqueror, it would establish a curious coincidence between the customs of the heroic and the middle ages, showing that, in both, the woes of the vanquished were cruelly aggravated by their being compelled to emblazon the causes of their captivity, in order to gratify the pride of their victors and masters. A very different question is suggested by this passage, namely, whether the ancients were acquainted with the art of weaving figured patterns. Homer directly asserts that they were, and informs us, that Andromache was engaged in producing a rich flowered pattern when she received the melancholy intelligence of the death of Hector:

> Far in the close recesses of the dome
> Pensive she ply'd the melancholy loom.
> A gloomy work employ'd her secret hours
> Confus'dly gay with intermingled flowers.

Now from the walls the clamours reach her ear,
And all her members shake with sudden fear;
Forth from her weary hands the shuttle falls,
Alarm'd, astonish'd, on her maids she calls.—*Iliad*, xxii.

Ovid goes much farther. In his description of the contest in weaving between Minerva and Arachne, he dwells not only on the beauty of the figures which the rivals wove, but also mentions the delicacy of shading by which the various colours were made to harmonize together:

Then both their mantles button'd to their breast,
Their skilful fingers ply with willing haste,
And work with pleasure, while they cheer the eye
With glowing purple of the Tyrian dye:
Or justly intermixing shades with light,
Their colourings insensibly unite
As when a shower, transpierced with sunny rays,
Its mighty arch along the heaven displays;
From whence a thousand different colours rise
Whose fine transition cheats the clearest eyes;
So like the intermingled shading seems
And only differs in the last extremes.
Then threads of gold both artfully dispose,
And, as each part in just proportion rose,
Some antic fable in their work disclose.—*Metam.* vi.

It may, however, be reasonably concluded that the loom was also used as an embroidery frame, and that the patterns were worked on the piece with the needle as the weaving proceeded. In no other way can we account for the sudden recognitions between relations arising from the identification of some peculiar pattern in a robe, and the bursts of tender affection to which they give rise, so frequently delineated by the tragic poets. Thus, in the Ion of Euripides, Creusa proves herself to be the mother of the youthful hero by describing the pattern of a shawl which she had made in her youth, and in which she had wrapped her infant son. In another of his dramas Iphigenia is introduced recognizing her brother Orestes by the figured clothing which he wore, and which she had long before woven for him.

A similar recognition between Electra and Orestes occurs in the Choëphoræ of Æschylus.

Vests of ornamental work, whether woven or embroidered, were favourite presents from a fond wife to her husband, from a mother to her son, and from a sister to her brother. Surcoats thus ornamented formed no small part of the ancient warrior's pride. A striking allusion is made to their importance in one of the most glowing passages of Deborah's triumphal hymn. "The mother of Sisera looked out at a window and cried through a lattice, 'Why is his chariot so long in coming? why tarry the wheels of his chariots?' Her wise ladies answered her, Yea, she returned answer to herself, 'Have they not sped? have they not divided the spoil; to every man a damsel or two; to Sisera a prey of divers colours, a prey of divers colours of needle-work, of divers colours of needle-work on both sides, meet for the necks of them that take the spoil.'" (Judges v. 28–30.)

The repetition of "the divers colours" in this passage is a strong proof of the value that was anciently set on this species of ornamental work. Indeed, their importance was so great that Moses has given the most minute directions for the preparation of the sacerdotal robes to be worn by the high-priest. It was expressly commanded that these vestments should be made of fine linen. "Thou shalt embroider the coat of fine linen, and thou shalt make the mitre of fine linen, and thou shalt make the girdle of needle-work." (Exod. xxviii. 39.)

Moses is the first who mentions the preparation of gold in threads to be interwoven with the most precious cloths. "They did beat the gold into thin plates, and cut it into wires, to work it in the blue, and in the purple, and in the scarlet, and in the fine linen with cunning work." (Exod. xxxix. 3.) From this passage it appears that the gold thread, or rather wire, used in weaving, was beaten out with the hammer into thin plates, divided longitudinally into wires by some sharp, cutting instrument, and then rounded on the

anvil. Indeed, Homer asserts that even the delicate gold-net made by Vulcan, the meshes of which were so fine that the Gods themselves could not see them, was forged by the Lemnian deity on his anvil, with his hammer:

> Stung to the soul, indignant, through the skies
> To his black forge vindictive Vulcan flies;
> Arrived, his sinewy arms incessant place
> The eternal anvil on the massy base.
> A wondrous net he labours, to betray
> The wanton lovers as entwined they lay,
> Indissolubly strong! Then instant bears
> To his immortal dome the finish'd snares.
> Above, below, around with art bespread
> The sure enclosure folds the genial bed,
> Whose texture e'en the search of gods deceives,
> Thin as the filmy threads the spider weaves.—*Odyss.* viii.

Lucan, in his description of the luxuries with which Cleopatra allured Julius Cæsar, incidentally asserts that the Egyptians united embroidery with weaving in the preparation of their richest and most expensive cloths:

> In glowing purple rich the coverings lie,
> Twice had they drunk the noblest Tyrian dye:
> Others, as Pharian artists have the skill
> To mix the party-colour'd web at will,
> With winding trails of various silks were made,
> Whose branching gold set off the rich brocade.
> *Pharsalia*, x.

The art of weaving in Egypt was usually connected with that of netting and lace-making, for the finer kinds of Egyptian net were a very near approach to the modern lace. In the prophet's denunciation of Divine vengeance against the land of the Pharaohs, the two trades are connected together: "Moreover, they that work in fine flax, and they that weave net-works shall be confounded." (Isaiah xix. 9.) The thin upper dresses worn by Egyptian ladies of high rank, which were so delicate as to be called woven air, appear to have been net-work of very fine mesh. Such a dress

was called by the Hebrews שֵׁבֶץ *shebetz;* and this word is the term by which Solomon describes the vesture worn by Pharaoh's daughter: the 45th Psalm, though it has a secondary and more holy signification, being in its primary and literal sense a hymeneal ode on his marriage with that princess. "The king's daughter is all glorious within; her clothing is of wrought gold; she shall be brought unto the king in raiment of needle-work, the virgins her companions that follow her shall be brought unto thee." (Psalm xlv. 13, 14.) The passage may be thus more literally rendered:

> All glorious is the king's daughter inwardly!
> Her net-works are of wrought gold;
> She shall be brought unto the king in an embroidered mantle;
> Her virgin attending companions shall be brought unto thee.

The use of *shebetz* for a vesture of net-work enables us to explain a passage in which several modern versions, including the English authorized version, have gone astray, by supposing that "a net" was used metaphorically for entanglement, and consequent pain. In the description which the young Amalekite gave David of the circumstances attending the death of Saul, he stated, "He said unto me again, Stand, I pray thee, upon me, and slay me; for anguish is come upon me, because my life is yet whole in me." (2 Sam. i. 9.) The phrase rendered "anguish is come upon me," literally signifies "this net-work has entangled me," clearly alluding to his coat of mail, which, as we see on the Egyptian monuments, was made of net-work, to which scales of metal were attached. This circumstance is a sufficient proof that the literal translation is preferable to the figurative, especially as there is no instance of the word *shebetz* being used metaphorically in any other part of scripture.

In another part of this work we shall have to investigate the nature of the materials which the Egyptians used in their textile fabric, and the progress they made

in the art of dyeing; we shall conclude this chapter with Lucan's account of the excellence to which they attained in the preparation of articles of female dress. He thus describes the costume of Cleopatra, when she received Julius Cæsar:

> Amidst the braidings of her flowing hair,
> The spoils of orient rocks and shells appear:
> Like midnight stars, ten thousand diamonds deck
> The comely rising of her graceful neck;
> Of wondrous work, a thin transparent lawn
> O'er each soft breast in decency was drawn,
> Where still by turns the parting threads withdrew,
> And all the panting bosom rose to view.
> Her robe, her every part, her air confess
> The power of female skill exhausted in her dress.
>
> *Pharsalia*, x.

CHAPTER II.

EARLY PROGRESS AND EXTENSION OF SPINNING AND WEAVING.

THOUGH Egypt, as we have seen, appears to have been the country in which the manufacture of textile fabrics earliest attained importance as a branch of national industry, yet in the age of Joshua weaving establishments were found in the land of Shinar, and most probably in the chief city of that district, ancient Babylon. "A mantle of Shinar," or, as our translators have rendered it, "a Babylonish garment," was secreted by Achan from the spoils of Jericho, and the delinquent speaks of it as the most valuable part of his plunder. Herodotus says, "The Babylonians wear a gown of linen flowing down to the feet; over this an upper woollen garment, and a white tunic covering the whole." Such a dress, particularly if the white tunic

were made of woollen, as the venerable historian seems to intimate, must have been too heavy for so warm a climate, particularly in summer, and hence we may be led to suspect that Herodotus included vegetable and animal wool in his description, especially as we know from other authorities, that the cotton manufacture was established in Babylon at a very early period.

From the book of Joshua, as already quoted, we learn that the woven stuffs of Babylon were not confined to domestic use, but were exported into foreign countries. The two chief productions of the Babylonian looms were carpets and shawls. The former, one of the principal objects of luxury in Asia, from the remotest ages, were nowhere so finely woven, and in such rich colours as at Babylon. We know not when the fashion of spreading them on floors was introduced, but the earliest Greek historians speak of them as commonly used for this purpose in the palaces of the mighty and the houses of the wealthy. On the Babylonian carpets were woven or depicted representations of those fabulous animals, the dragon, the griffin, and other unnatural combinations of form, probably originating in India, with which we have become acquainted by the ruins of Persepolis. It was by means of the Babylonian manufactures that the knowledge of these fanciful and imaginary beings was conveyed to the western world, and from them they were transferred to the Greek vases. Foreign nations made use of the Babylonian carpets in the decoration of their *harems* and royal saloons; but nowhere was this species of luxury carried to such an excess as amongst the ancient Persians. With them not only the floors, but even beds and sofas in the houses of the nobles were covered with two or three of these carpets; nay, the oldest of their sacred edifices, the tomb of Cyrus at Pasargada, was ornamented with a purple carpet of Babylonian workmanship. Sir Gardiner Wilkinson, on the authority of Diodorus Siculus, informs us, that carpets were used in Egypt, where they were spread for the

sacred animals; and Homer reckons a carpet among the luxuries with which Menelaus, who had visited Egypt, astonished Telemachus when he received that prince in the palace of Sparta:

> The seat of majesty Adraste brings
> With art illustrious for the pomp of kings.
> To spread the pall beneath the regal chair,
> Of softest wool, is bright Alcippe's care.—*Odyssey*, iv.

"Of the quality of the Egyptian carpets," says Sir Gardiner Wilkinson, "we are unable to form any opinion, the fragments discovered in the tombs being very imperfectly preserved. Some portions of woollen work have been found at Thebes, which presented the appearance of a carpet; and a small rug was lately brought to England, and is now in the possession of Mr. Hay.

"This rug is eleven inches long, by nine broad. It is made, like many carpets of the present day, with woollen threads on linen string. In the centre is the figure of a boy in white, with a goose above it, the hieroglyphic of 'child' upon a green ground; around which is a border composed of red and blue lines; the remainder is a ground of yellow with four white figures above and below, and one on each side, with blue outlines and red ornaments; and the outer border is made up of red, white, and blue lines, with a fancy device projecting from it with a triangular summit which extends entirely round the edge of the carpet. Its date is uncertain; but from the child, the combination of the colours, and the ornament of the border, I am inclined to think it really Egyptian.

"I have also been informed by Lord Prudhoe, that in the Turin museum he met with some specimens of worsted worked upon linen, in which the linen threads of the weft had been picked out, and the coloured worsted sewed on the warp."

The Babylonian shawls, like those of modern Persia, were adorned both with gold and variously coloured figures. Hence Publius Syrus compared a Peacock's tail to a figured Babylonian mantle enriched with gold.

Their magnificent appearance and exquisite texture are celebrated both by the Greek and Roman writers; it was always deemed to be one of the most singular displays of asceticism in the elder Cato, that he immediately gave away a splendid Babylonian shawl which some foreign potentate had bequeathed to him as a remuneration for political services.

Next to the carpets and shawls, the Babylonian garments called *Sindones* were held in the highest estimation. From the descriptions given of them it would appear that they were in all probability a cotton-fabric, though some may have been occasionally made from linen; for we find from the Levitical law, that linen had some religious significance. The most costly *Sindones* were so highly valued for their fineness of texture and brilliancy of colour as to be compared to those of Media, and set apart for royal use; they were even to be found at the tomb of Cyrus, which was profusely decorated with every species of furniture in use among the Persian monarchs during their lives. The superiority of the textile fabrics of Babylonia must be ascribed to their spirit of commercial freedom. We do not find in their history, so long as they remained a commercial and manufacturing people, any proof that they ever imposed restrictions upon the import of the raw material of manufactures, or that which may be called the raw material of operatives, namely, human food. When the barbarous Chaldæans conquered the country and introduced the spirit of monopoly, the commercial spirit of Babylonia was cankered at the root, and its pre-eminence destroyed.

The Tyrians are chiefly known to us in commercial history for their skill in dyeing; the Tyrian purple formed one of the most general and principal articles of luxury in antiquity: but dyeing could scarcely have existed without weaving, and though we have no direct information respecting the Tyrian and Sidonian looms, we possess several ancient references to their excellence, the less suspicious because they are incidental. Homer,

for instance, when Hecuba, on the recommendation of the heroic Hector, resolves to make a rich offering to Minerva, describes her as selecting one of Sidonian manufacture as the finest which could be obtained.

> The Phrygian queen to her rich wardrobe went
> Where treasured odours breathed a costly scent;
> There lay the vestures of no vulgar art—
> Sidonian maids embroider'd every part,
> Whom from soft Sidon youthful Paris bore
> With Helen, touching on the Tyrian shore.
> Here, as the queen revolved with careful eyes
> The various textures and the various dyes,
> She chose a veil that shone superior far,
> And glow'd refulgent as the morning star.—*Iliad*, vi.

From the interesting history of his adventures, which Eumæus gives to Ulysses, we learn that Phœnician women, on account of their skill in weaving, were frequently kidnapped by the pirates of the Levant, and sold in the Greek islands.

> Freighted it seems with toys of every sort
> A ship of Sidon anchor'd in our port;
> What time it chanced the palace entertain'd,
> Skill'd in rich works, a woman of their land;
> This nymph, where anchor'd the Phœnician train,
> To wash her robes descending to the main,
> A smooth-tongued sailor won her to his mind
> (For love deceives the best of womankind).
> A sudden trust from sudden liking grew—
> She told her name, her race, and all she knew.
> "I, too," she cried, "from glorious Sidon came,
> My father, Arybas, of wealthy fame;
> But, snatch'd by pirates from my native place,
> The Taphians sold me to this man's embrace."—*Odyssey*, xv.

It appears, that the principal textile fabrics of Tyre were woollens; this, indeed, might have been expected from the celebrity of their dyes, for animal filaments always take a finer colour than vegetable substances; and we shall hereafter have occasion to notice, that calico-printers are forced to employ a process which may be regarded as something very like an animalization of

for their most important manufactures. This circumstance, too, was a means of cementing and preserving a good understanding between them and these nomad tribes; a matter of no inconsiderable importance to the Phœnicians, as it was through the nomads that the rich produce of the southern regions came into their hands."

One great source of the manufacturing prosperity of Tyre was the absence of restrictions on the importation of human food. The twenty-seventh chapter of Ezekiel, which Michaelis justly describes as the most ancient monument of commercial history, informs us, that Palestine was the granary of the Phœnicians. Their own mountainous territory was but little adapted for agriculture, and they were too wise to force unproductive soils into cultivation by bounties and protecting duties; Palestine, their commercial ally, produced corn in sufficient abundance to be able to supply them plentifully with this first necessary of life. This is expressly declared by the prophet: "Judah and the land of Israel, they were thy merchants: they traded in thy market wheat of Minnith, and Pannag, and honey, and oil, and balm." (Ezek. xxvii. 17.) Heeren has very properly called attention to the marked effect of this commercial intercourse in preserving the harmony of the two nations; it is, indeed, a memorable example of freedom of trade becoming the very bond of peace.

"The fact that Palestine was the granary of the Phœnicians, explains in the clearest manner the good understanding and lasting peace that prevailed between these two nations. It is a striking feature in the Jewish history, that with all other nations around them they lived in a state of almost continual warfare; and that under David and Solomon, they even became conquerors and subdued considerable countries, and yet with their nearest neighbours, the Phœnicians, they never engaged in hostilities. But if a sense of their weakness prevented them from attacking these mighty cities, the natural

policy of the Phœnicians no less on the other hand restrained them from any hostile attempt on a country from which they drew their subsistence: to which it may be added, that it seems to have been a maxim among them to avoid all wars and forcible extension of their dominion of the continent of Asia."

We learn from Ezekiel that although the Phœnicians were manufacturers themselves, they freely imported textile fabrics from other countries. "Fine linen with broidered work from Egypt was that which thou spreadest forth to be thy sail; purple and scarlet from the isles of Elishah was that which covered thee."* (Ezekiel xxvii. 7.) The Egyptian manufactures have been already mentioned; "the isles of Elishah?" are a name given to the islands and southern peninsula of Greece, and this name was for many centuries perpetuated in that part of the Peloponnesus called Elis. This passage affords another singular proof of the freedom of commerce established among the Tyrians; for, though dyeing in purple was one of the staple branches of their national industry, we find them freely importing purple stuffs from the Peloponnesus.

Only vague and uncertain traditions or allusions in the ancient poets give us any information respecting the progress of textile industry in Asia Minor, the Ionian colonies, and the islands of the Ægean. Homer, as we have already seen, represents the Trojan ladies as peculiarly devoted to the spindle and loom; and Theocritus in his exquisite Eighteenth Idyll, the Epithalamium of Helen, introduces the Trojan ladies celebrating the skill of Helen in weaving, as not less worthy of praise than her unrivalled charms.

> When winter thus in night no longer lours
> And spring is usher'd by the blooming hours,
> The rising morning, with her radiant eyes,
> Salutes the world, and brightens all the skies.

* We follow here the version of Michaelis,

So shines fair Helen, by the Graces drest,
In face, shape, size, superior to the rest:
As corn the fields, as pines the gardens grace,
As steeds of Thessaly the chariot race;
So Helen's beauties bright encomiums claim,
And beam forth honour on the Spartan name.
What nymph can rival Helen at the loom
And make fair art like living nature bloom?
The blended tints, in sweet proportion join'd,
Express the soft ideas of her mind.—*Idyll*, xviii.

Both Horace and Virgil have celebrated the fine woollen cloths of Miletus, which were held in high esteem by the Roman ladies; but it is not easy to determine whether any weaving factories were established in this splendid and wealthy Ionian city, as in Egypt, or whether the labours of the spindle and loom were merely domestic employments as in Greece and Italy. Theocritus has given us a very striking proof of the pleasure which the women of Miletus took in these employments; for, when he went to visit his friend Nicias, the Milesian physician, to whom he had previously addressed his eleventh and thirteenth Idylls, he carried with him an ivory distaff as a present for Theugenis, his friend's wife. He accompanied his gift with the following verses, which modestly commend the matron's industry and virtue, and, at the same time, throw an interesting light on the domestic economy of the ladies of Miletus:

O Distaff, friend to warp and woof,
Minerva's gift in man's behoof,
Whom careful housewives still retain,
And gather to their households gain;
With me repair, no vulgar prize,
Where the famed towers of Nileus rise,*

* Miletus was called "the towers of Nileus," from its having been founded by Nileus, the son of the celebrated king Codrus, who devoted himself for the safety of Athens. Nileus was so indignant at the abolition of royalty on his father's death, that he migrated to Ionia.

Where Cytherea's swayful power
Is worship'd in the reedy bower.
Thither, would Jove kind breezes send,
I steer my course to meet my friend,
Nicias, the Graces honour'd child,
Adorn'd with sweet persuasion mild,
That I his kindness may requite—
May be delighted, and delight.
Thee, ivory distaff, I provide,
A present for his blooming bride;
With her thou wilt sweet toil partake
And aid her various vests to make.
For Theugenis the shepherds shear
The sheep's soft fleeces twice a year.
So dearly industry she loves
And all that wisdom points, approves,
I ne'er design'd to bear thee hence
To the dull house of Indolence;
For, in that city thou wert framed
Which Archias built, Corinthian named,—
Fair Syracuse, Sicilia's pride,
Where troops of famous men abide.
Dwell thou with him whose art can cure
Each dire disease that men endure;
Thee to Miletus now I give,
Where pleasure-crown'd Ionians live;
That Theugenis by thee may gain
Fair honour with the female train;
And thou renew within her breast
Remembrance of her muse-charm'd guest.
Admiring thee, each maid will call
The favour great, the present small;
For love the smallest gift commends,
All things are valued by our friends.—*Idyll*, xxviii.

In another Idyll the poet incidentally notices the great superiority in textile manufacture of the Greeks, who had settled in Eastern countries, over those who had colonized Sicily and Southern Italy: we allude to the very amusing record of the gossip between two Syracusan ladies, who had come to Alexandria for the purpose of witnessing the magnificent shows and solemnities, prepared by Arsinoë, the queen of Ptolemy Philadelphus, to celebrate the festival of Adonis, revived under her auspices. Nothing seems to have excited the wonder of

these fair ladies more than the magnificent tapestries which adorned the Græco-Egyptian palace of the Ptolemies, and they express their astonishment very naturally after having elbowed their way through the crowd.

PRAXINOE.

See how the folks, poor Erinoë, jostle!
Push through the crowd, girl!—bustle, bustle!
Now we're all in.

GORGO.

Lo! what rich hangings grace the rooms!—
Sure they were wrought in heavenly looms!

PRAXINOE.

Gracious! how delicately fine
The work! how noble the design!
How true, how happy is the draught!
The figures seem inform'd with thought—
No artist sure the story wove—
They 're real men,—they live, they move.
From these amazing works we find
How great, how wise the human mind!
Lo! stretch'd upon a silver bed,
(Scarce has the down his cheeks o'erspread)
Adonis lies! O charming show!
Loved by the sable powers below!

STRANGER.

Hist! your Sicilian prate forbear,
Your mouths extend from ear to ear;
Like turtles that for ever moan
You stun us with your rustic tone.

GORGO.

Sure! we may speak! What fellow's this?
And do you take it, sir, amiss?
Go, keep Egyptian slaves in awe;
Think not to give Sicilians law.—*Idyll*, xv.

There is not a little humour in the gossiping, gad-about Syracusan ladies thus unceremoniously branding the Greek ladies of Egypt as slaves, because they stayed at home to attend to the labours of the spindle and shuttle instead of running about the streets to see the gorgeous spectacles of the festival. The poet in several

other passages refers to the domestic industry of the Asiatic Greeks, so different from the indolence of the fair Sicilians.

The island of Cos very early enjoyed a high reputation for its textile fabrics and their excellent purple dyes. In the age of Augustus they were esteemed the most becoming ornaments to ladies anxious to direct attention to their charms. Hence Horace, reproaching Lyce, says,

> Not Coan purple, nor the blaze
> Of jewels, can restore the days,—
> To thee, those days of glory,
> Which wafted on the wings of time,
> E'en from thy birth to beauty's prime
> Recorded stand in story.—*Book* iv. *Ode* xiii.

From the description which Horace gives of the Coan robes in the second satire of his first book, and from the parallel passages in contemporary poets, we learn that the Coan robe had a great degree of transparency, that it was remarkably fine, that it was chiefly worn by women of light character, that it was usually dyed purple, and sometimes enriched with stripes of gold. It has been supposed to have been made of silk, because, as we learn from Aristotle, silk was at a very early period spun and woven in Cos, and was the chief cause of the high celebrity attained by the manufactures of that island. Hence Tibullus promises his mistress,

> Since beauty sighs for spoil, for spoil I 'll fight!
> In all my plunder Nemesis shall shine.
> Yours be the profit; be the peril mine.
> To deck your heavenly charms the silkworm dies,
> Embroidery labours, and the shuttle flies.—*Eleg.* ii. 6.

In a painting discovered at Pompeii, there is a representation of a lady weaving a tunic of almost perfect transparency, which may probably have been a Coan vest; but, so far as we are enabled to judge from such imperfect evidence, we should believe it to be a thin muslin. Pliny, however, distinctly asserts, that the

Coan dresses were made of silk. "The Grecian women," he says, "unravel the silks imported from Asia, and then weave them anew; whence that fine tissue of which frequent mention is made in the Roman poets under the name of *Coan vests*." Salmasius has shown that Pliny in this passage misunderstood the passage of Aristotle's Natural History to which he referred. The Greek means nothing more than "females wind off the web of the silkworm, and then weave the threads," not as Pliny would interpret it, "unravel the texture of the dress, and then weave it over again."

The practice of weaving in the island of Scyros is proved by the description which the poets have given of the occupations of Achilles when concealed there in a female dress. This tale is prettily told by Moschus:—

> In close disguise his life Achilles led
> Among the daughters of King Lycomed:
> Instead of arms the hero learn'd to cull
> The snowy fleece, and weave the twisted wool.
> Like theirs, his cheeks a rosy bloom display'd;
> Like them, he seem'd a fair and lovely maid;
> As soft his air, as delicate his tread;
> Like them, he cover'd with a veil his head.—*Idyll.* vii.

Lesbos was also remarkable for the practice of weaving as an important branch of domestic industry. Among the fragments of Sappho, we find part of an ode addressed by the poetess to her mother, as an apology for neglecting the labours of the loom:

> Cease, gentle mother, cease your sharp reproof,
> My hands no more can ply the curious woof;
> While on my mind the flames of Cupid prey,
> And lovely Phaon steals my soul away.—*Frag.* iv.

The fable of Hercules and Omphale proves that textile manufactures were very early established in Lydia; they were patronized by the kings of the successive dynasties; and some of the spinning and weaving estab-

CHAPTER III.

SPINNING AND WEAVING IN GREECE AND ROME.

Textile fabrics, at least those of the finest description, were imported from Asia, during the classical ages, at a cheaper rate than they could be produced in Greece, and as the nonsense of protecting duties was a discovery reserved for the barbarism of the middle and dark ages, no efforts were made to misdirect the natural bent of native industry by establishing prohibitions and monopolies which might afford an uncertain, and at best a small gain to the few, at the great and certain loss of the many. There were, however, several large manufactories for the weaving of *pallia*, a word which might be more properly translated *blankets* than cloaks. They were indeed sometimes coloured, but in these cases the wool was dyed in its raw state, and the palls were worn in the very form in which they were taken from the loom. They were rectangular pieces of cloth, nearly square, and were used indifferently for cloaks by day and for coverlets by night; we find them also employed as horse-cloths, and even as carpets. Thus in St. Luke's description of Christ's triumphal entry into Jerusalem, we read that the disciples "cast their garments upon the colt, and they set Jesus thereon: and as he went, they spread their clothes in the way." (Luke xix. 35, 36.) This was an oriental form of recognising Jesus as king, and it is still observed in many eastern countries during the royal progresses of their monarchs. The cumbrous palls were usually laid aside when any work was to be done requiring great exertion. Thus we read in the Acts of the Apostles, that those who went to stone the Proto-martyr

Stephen, "laid down their cloaks at the feet of Saul." (Acts vii. 58.) Thus also Telemachus, when attempting to bend the bow of Ulysses,

> His girdle loosed, his glitt'ring sword unbound,
> And cast his purple mantle on the ground.—*Odyssey*, xxii.

Sometimes, however, the *pall* was gathered close round the body, leaving the upper part of the frame naked; a custom to which the phrase, "making bare the arm," of such frequent occurrence in the Old Testament, obviously alludes. In an old hymn we find,

> Make bare thine arm, great King of kings,
> Thine arm alone salvation brings.

There were many establishments for the weaving of blankets and palls both in Greece and Italy; but particularly in Megara, where the manufacture of coarse blankets formed the staple trade of the country. The work was performed by slaves who wrought in factories, the spinning being usually performed by females and the weaving by males. Several factories of the same kind were established in Italy, but their productions were chiefly used by the working classes; persons of superior rank either used dresses imported from the East, or those which were wrought in their own household.

We must regard the spinning and weaving of Greece and Italy as a purely domestic manufacture; indeed, every considerable house, especially in the rural districts, had its spinning and weaving rooms, with all the apparatus necessary for the manufacture both of flax and wool. Thus Virgil, in his description of rural employments during winter:

> The wife and husband equally conspire
> To work by night, and make the winter fire;
> He sharpens torches in the glimmering room,
> She shoots the flying shuttle through the loom.—*Georgic*, i.

Even in very late years the reel and loom were common articles of furniture in thriving farm-steads in parts

of Ireland and Scotland; tailors travelled about to make or mend clothes of home-spun and home-woven yarn; but it was commonly remarked that those who attempted to unite manufactures and agriculture were bad farmers and worse weavers.

The Roman and Grecian ladies displayed not less taste in the decoration of their various spinning implements than those of modern times in the ornaments of their work-table. The *calathus* or *qualus* was the basket in which the wool was kept for the fair spinsters. It was usually made of wicker-work. Thus Catullus in his description of the nuptials of Peleus and Thetis:

> The softest fleeces, white as driven snow,
> Beside their feet in osier baskets glow.—*Poema*, lxiv.

Homer asserts that the Egyptian queen Alcandra presented Helen with a silver work-basket as well as a golden distaff (Odyss. iv.); and from the paintings on ancient vases, we see that the *calathi* of ladies of rank were tastefully wrought and richly ornamented. From the term *qualus* or *quasillus*, equivalent to *calathus*, the Romans called the female slaves employed in spinning *quasillariæ*, and these were regarded as the meanest in the household.

The material prepared for spinning was wrapped loosely round the distaff, the wool being previously combed, or the flax hackled by processes not very dissimilar to those used in the present day. The ball thus formed on the distaff required to be arranged with some neatness and skill, in order that the fibres should be sufficiently loose to be drawn out by the hand of the spinner. Ovid declares, that Arachne's skill in this simple process excited the wonder of the nymphs who came to see her triumphs in the textile art, not less than the finished labours of the loom.

> Oft, to admire the niceness of her skill,
> The nymphs would quit their fountain, shade, or hill:
> Thither from green Tymolus they repair,
> And leave the vineyards, their peculiar care;

Thither from fair Pactolus' golden stream,
Drawn by her art, the curious Naids came.
Nor would the work, when finish'd, please so much
As while she wrought to view each graceful touch;
Whether the shapeless wool in balls she wound,
Or with quick motion turn'd the spindle round.—*Met.* vi.

The distaff was generally about a yard in length, commonly a stick or reed, with an expansion near the top for holding the ball. It was sometimes composed of richer materials; we have already quoted the Idyll of Theocritus written on the occasion of sending an ivory distaff to the wife of his friend, and the passage in which Homer mentions the golden distaff presented by Alcandra to Helen. The distaff was usually held under the left arm, and the fibres were drawn out from the projecting ball, being, at the same time, spirally twisted by the forefinger and thumb of the right hand. The thread so produced was wound upon the spindle until the quantity was as great as it would carry.

The spindle was made of some light wood, or reed, and was generally from eight to twelve inches in length. At the top of it was a slit, or catch, to which the thread was fixed, so that the weight of the spindle might carry the thread down to the ground as fast as it was finished. (See the wood-cut of Egyptian Spinsters, page 4.) Its lower extremity was inserted into a whorl, or wheel, made of stone, metal, or some heavy material which both served to keep it steady and to promote its rotation; as every school-boy who has ever made a whirligig can easily comprehend. The spinner who, as we have said before, was usually a female, every now and then gave the spindle a fresh gyration by a gentle touch so as to increase the torsion of twist of the thread. Whenever the spindle touched the ground a length was spun; the thread was then taken out of the slit, or clasp, and the thread just finished wound upon the spindle; the clasp was then closed again, and the spinning of a new thread commenced. All these circumstances are briefly

mentioned by Catullus in a poem from which we have already quoted:

> The loaded distaff, in the left hand placed,
> With spongy coils of snow-white wool was graced;
> From these the right hand lengthening fibres drew
> Which into thread 'neath nimble fingers grew.
> At intervals a gentle touch was given
> By which the twirling whorl was onward driven.
> Then, when the sinking spindle reach'd the ground,
> The recent thread around its spire was wound,
> Until the clasp within its nipping cleft
> Held fast the newly-finish'd length of weft.

Distaffs and spindles of this kind were commonly used in the Spanish peninsula at a very recent period, and it is probable, that they may still be found in some of the more remote districts. They were also used by the peasantry in the west of Ireland, some of whom are known to be of Spanish descent. As the bobbin of each spindle was loaded with thread, it was taken off from the whorl and placed in a basket until there was a sufficient quantity for the weavers to commence their operations.

The threads of the warp, or longitudinal fibres, were always stronger than those of the weft, or thread, shot through the warp by the shuttle. In general the Greeks and Romans used an upright loom, not very unlike that of the ancient Egyptians, but more closely approaching in lightness and neatness the embroidery frames used by modern ladies in working with Berlin work. In fact, such a frame placed erect, having the warp-thread wound on the upper bar, and then passing the whole length of the frame to the lower bar, with leash rods somewhere about the centre to keep the alternate threads of the warp separate, would be no inadequate representation of a Roman loom of the upright kind. The weaver in working at this loom was obliged to stand and move about in directing the shuttle, especially if the cloth to be woven exceeded a very moderate

breadth. The horizontal loom to which weavers sit, was, indeed, known in ancient times, but does not appear to have been much used before the third or fourth century of the Christian era. In the Egyptian loom the process of weaving proceeded upwards, and the weft, after being shot through, was driven home by an iron bar. In most of the old Grecian and Roman looms the process of weaving was downwards, and the weft was driven home by an instrument called a *spatha*, which was similar to a wooden sword. In later times the *spatha* was superseded by a comb, and this is the instrument still used by the Hindoos. In our looms the process is effected by the *reed*, or *batten*.

The looms of the Northern nations, such as are used to this day in Iceland, were similar to the upright looms of the Romans, and were woven downwards. But the Romans appear to have kept their warp yarns parallel by rolling them carefully on a cylinder, which unwound and gave out yarn as it was wanted—a process which in modern manufactures is called "beaming the yarn;" while the Northern nations were forced to pass the threads of the yarn over a transverse rod or plank, and then dividing them into thirty or forty parcels, to attach a stone or some other heavy weight to each parcel, for the purpose of keeping the warp-yarns firm in their perpendicular direction and allowing free play for the stroke of the *spatha*. These circumstances elucidate the curious mystic ode of the eleventh century, which Gray has translated from the Norse tongue with singular success:

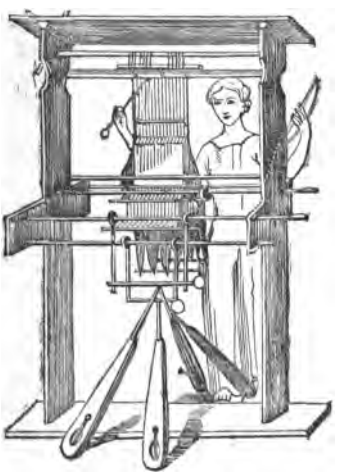
Now the storm begins to lower,
(Haste, the loom of Hell prepare,)
Iron sleet of arrowy shower
Hurtles in the darken'd air.

Glittering lances are the loom
Where the dusky warp we strain,
Weaving many a soldier's doom
Orkney's woe and Randver's bane.

See the grisly texture glow
('Tis of human entrails made),
And the weights that play below
Each a gasping warrior's head.

Shafts for shuttles, dipt in gore,
Shoot the trembling cords along;
Sword, that once a monarch bore,
Keep the tissue close and strong.

Striped patterns were produced by changing the colour of the weft at regular intervals, and check patterns by alternating the colours in the warp. Twilled cloths and



damasked patterns were produced by a complicated arrangement of the lease-rods, which rendered these productions very expensive; and, in some few instances, figured patterns were undoubtedly woven. The pictorial and complicated patterns described by the poets must either have been printed or embroidered.

About the third century cloth of a considerable

breadth began to be woven, and, as we see in the accompanying engraving, two women were then employed at the loom. The great strength necessary to throw the shuttle made this labour very fatiguing, and in the fourth century the task of weaving began to be transferred in Europe from women to men. St. Chrysostom preached against this change, which he deplored as a sign of prevailing sloth and effeminacy. Vegetius, who wrote about the same time, mentions *linteones*, or manufacturers of linen cloth, in the number of those who were ineligible as soldiers. Little is known of the subsequent progress of the textile arts, until manufacturing industry received a new impulse from the introduction of the silk-worm into Europe, in the reign of the emperor Justinian.

CHAPTER IV.

EARLY HISTORY OF THE TEXTILE ARTS IN BRITAIN.

THE history of British manufacturing industry is a record of the most preposterous legislative efforts to annul the laws of nature, such as were probably never equalled, and certainly could not be exceeded, in any other country in the world. Laws for the winds, and statutes for the whirlwinds, would be the perfection of wisdom compared with the enactments in our ancient commercial codes, and it is doubtful whether direct hostility could have effected more injury to the labouring classes than the bear-hug of mistaken protection. One great source of this perverse legislation was, that the Norman barons amongst whom William the Conqueror had parcelled the lands of England on the tenure of military service—that is, providing for the defence of

the country—not only pursued a course of fiscal policy by which the public revenues were raised out of taxation on industry instead of being defrayed out of rental, but also employed sometimes violence and sometimes fraud to secure to themselves a share in the profits of trade and commerce, though feudal pride prevented them from participating in the labours of either pursuit.

Nothing could have enabled the British nation to bear up under the barbarous and short-sighted policy of the Norman aristocracy, but the sturdy industrial spirit derived from the Saxon race. Industry, so far from being regarded as undignified by the Anglo-Saxons, was an honourable boast, and was worthily associated with their religion. In their belief, the physical portion of the curse pronounced after the Fall, extended only to the earth, and was compensated by the promise to Adam, "In the sweat of thy brow thou shalt eat bread." In their Scripture illustrations the Angel of Mercy is introduced, consoling our first parents for their expulsion from Paradise, and the boons by which this personification of Divine Benevolence alleviates their grief are, the gift of a spade to Adam, and of a spindle to Eve, equally showing that they regarded the necessity of labour as imposed upon man by a merciful economy in the moral government of the universe, and that they looked upon the machinery which aided and facilitated human toil as a direct blessing from heaven. In fact, Dr. Dewey's eloquent eulogy on labour may be fairly taken as an exposition of the principles of the Anglo-Saxon race. "Honour, if you please, to unchallenged indolence; for it reposes on treasure that labour sometime gained and gathered. It is the effigy of a man upon a splendid mausoleum; somebody built that mausoleum; somebody put that dead image there. Honour to him that does nothing, and yet does not starve; he hath his significance still; he is a standing proof that *somebody* has worked.

"But rather let us say, honour to the worker—to

the toiler—to him who produces and not alone consumes—to him who puts forth his hand to add to the treasure-heap of human comforts, and not to take away! Honour to him who goes forth amidst the struggling elements to fight his battle, and shrinks not with cowardly effeminancy behind pillows of ease! Honour to the strong muscle and the manly nerve, and the resolute and brave heart! Honour to the sweating brow and the toiling brain! Honour to the great and beautiful offices of humanity—to manhood's toil and woman's task—to parental industry, to maternal watching and weariness—to teaching wisdom and patient learning—to the brow of care that presides over the State, and to many-handed labour that toils in the workshop and fields, beneath its sacred and guardian sway!"*

Nor was this a mere theory with the Anglo-Saxons; the principles were acted upon in every rank and condition of life. Females of the highest rank did not disdain the labours of the distaff, the loom, and the needle. The daughters of King Edward the Elder were regularly instructed in spinning and in weaving; the immortal Alfred, in his last will, describes the females of his family as "the spindle side." The art of weaving variegated patterns was so common, that Aldhelm quotes it as an illustration in one of his homilies. The passage is curious not only as a specimen of Saxon oratory, but for the information it contains respecting the textile fabrics of the Saxon age. He is delivering an eulogy on one of the virtues which he says is insufficient of itself to constitute a perfect character, and he illustrates his argument by stating that "it is not a web of one uniform colour and texture, without any variety of figures, that pleases the eye and appears beautiful, but one that is woven by shuttles, filled with threads of purple and many other colours, flying from side to side, and forming a variety of figures and images in different compartments with admirable art."

* Dewey's Moral Views, p. 98.

It seems probable, judging from the illuminations of ancient manuscripts, that the Saxons made more use of woollens than of linens; indeed, an old legendary tale preserved in the collection of the brothers Grimm, represents the spinning of flax as a most extraordinary acquirement, which was not to be thoroughly gained but by supernatural assistance. It is singular that this same legend should also be found in Ireland. The Irish version of the story has never been printed, and we shall therefore give it as we took it down from the recitation of a poor old woman, famous among the peasantry for her skill in story-telling, some years ago.

"There was once an old woman and her daughter who lived at the side of a hill in the midst of a forest. They were very poor, and their only source of support was the thread which the daughter spun with her spindle and distaff. During the long winter, when the roads were so bad that the merchants could not come round to purchase the thread, the daughter, who was one of the most lovely creatures in the world, worked without cessation, in order that she might have enough of thread when the spring market came, to purchase a red cloak for her mother and a snood for herself, that they might go in proper attire to their devotions. It so happened that the king's son, while hunting, went astray in the forest, and went to the widow's cottage to inquire his way. He was greatly struck with the girl's beauty, and not less with the numerous hanks of yarn which equally attested her skill and industry. He inquired how it happened that they had collected such an immense pile, and the old woman replied that her daughter had spun the whole in a week. 'In a week!' exclaimed the astonished prince. 'If this be true, I have found a wife more worthy and valuable than any other in the country. I will send you a load of flax, and if she has it spun by the end of a week, I will choose her as my bride; but if not, I will have you both cut in

pieces and thrown to the dogs for deceiving the son of your sovereign.'

"On the very next day a long train of pack-horses laden with flax stood before the door of the cottage, and the drivers having unloaded them told the girl that she must spin this quantity in a week, or prepare for death. When they departed, her heart was crushed with despair; she, however, was unwilling to reproach her mother even by a look, but she went into the forest and sitting down under a tree began bitterly to bemoan her sad fate. While she was weeping and lamenting an old decrepid man came up and inquired the cause of her tears. She told him her story. 'Do not weep, daughter,' he said, 'I will execute every one of the tasks imposed upon you by the prince, provided that you will either give me your eldest son when he is twelve months and a day old, or that you shall in the intervening time find out my name.' She agreed to the terms. The old man, by some mysterious agency, conveyed away the flax, and about an hour before the time appointed for the prince's arrival, returned with the finest and best twisted thread that had ever been seen in the country. The prince, according to his promise, married the girl, and conveyed her, with her mother, to the palace. Every Monday morning he gave her out the quantity of flax which he expected to be spun during the week, and every Saturday night the yarn was made ready for him by the mysterious old man.

"At length the princess became the mother of a beautiful boy, and the thoughts of the bargain she had made almost drove her to distraction. Every effort she made to discover the name of the wonderful spinner utterly failed, and he at every visit reminded her that the time was near when he would have the right to claim the child.

"One evening as she sat oppressed with melancholy, her husband, who had just returned from hunting, in-

quired the cause of her sadness, but she was unable to answer him a word. 'Come, my love,' said he, 'do not be cast down, and I will entertain you with an account of a very surprising incident which occurred to me this very day. I lost my way while pursuing a fine stag, which ran towards the great rocks beyond the forest; while searching for his lurking place I thought I heard a human voice, and, following the direction of the sound, I came to a cave where I saw an old man, who did not notice my approach, so deeply was he engaged in a strange sort of labour: he was spinning, not as you do with the distaff, but with wheels which flew round as rapidly as lightning, and gave out thread like water falling from a mountain torrent; and all the while he never ceased singing,

Little my mistress she knows my name
Which sha 'nt be forgot, which sha 'nt be forgot,
When a prince as heir to the fortunes I claim
Of Wallotty Trot, Wallotty Trot.

"The princess made her husband repeat these rhymes several times until she was sure that she remembered them perfectly, and then waited with confidence for the return of the old man. He came at the appointed time and claimed the child. 'Stop, friend,' said she, 'there goes another word to that bargain; I have found out your name,—it is Wallotty Trot.' 'You have indeed detected my name,' said the old man, 'and my business on earth is well nigh finished. Before I disappear, however, I am bound to tell you the secrets of my art.' So saying, he went to the forest and returned with the wheels. He then taught the lady their use, showing her that she could spin seven times more with them than with the distaff; after which he disappeared and was never seen again. The prince and princess taught this new branch of industry to their subjects, and so enriched the state, that all the surrounding nations regarded them with envy and admiration."

This is a very curious mythological account of the ori-

gin of the spinning-wheel; we have only found it in the popular legends of Germany and Ireland; but we must add that, in the latter country, it is not strictly national, being only found in the localities most thickly inhabited by families of English descent. Some trace of a similar legend in England is preserved in the sports of children in the rural districts: it forms part of a rude drama preserved by oral tradition, and one of the characters is made to say, "I have come over rocks, reels, and old spinning-wheels, for one of your best children." The principal value of the legend is the proof it affords of the importance attached to domestic industry, when skill in spinning was deemed a sufficient reason for raising an humble peasant girl from a cottage to be the sharer of a throne.

Wool was the most important article of British produce; and the Plantagenet monarchs endeavoured to secure for themselves a large share of the profits arising from all transactions connected with it, by forbidding it to be bought or sold in any markets except the staple towns. Considerable embarrassment was produced by frequent changes of the staple; and, as these alterations were usually made for the convenience of foreign purchasers, they laid the foundation of that jealousy of foreigners which more than any other cause has deranged the commerce of England. In 1261, the barons, enraged by the partiality which Henry III. showed to the French connexions of his queen, passed a law prohibiting the exportation of wool, and ordaining that no woollen cloths should be worn except such as were woven at home. At this time, raw wool was the most important of British exports; for, in 1349, we find the parliament remonstrating that the king, by an illegal imposition of forty shillings on each sack of wool exported, had levied 60,000*l.* a year, which would make the annual export of wool eleven millions of pounds avoirdupois. The medium price of wool at the time was about 5*l.* per sack; the whole annual value of export 150,000*l.*

Such a sum was too important to the producers to be lost; the law prohibiting exportation was either repealed or permitted to fall into desuetude, for about the middle of the fourteenth century, we find that wool constituted about thirteen-fourteenths of the entire exports of the kingdom.

Little cloth was made in England, and that only of the coarsest description, until Edward III., in the year 1331, invited weavers, dyers, and fullers to come over from Flanders and settle in England, promising them his protection and favour on condition that they would carry on their trades here, and teach the knowledge of them to his subjects. The native wool-growers and merchants looked upon these foreign manufacturers with very jealous eyes, especially when Edward created a monopoly in their favour, by prohibiting the wearing of any cloth but of English fabric; and many petitions are preserved from the weavers of woollen stuffs, complaining of the heavy impositions laid upon them by the corporations, in which the corporation of Bristol is especially conspicuous. The manufacture, however, took root and flourished, though it received a severe check from the jealousy of parliament, which, by a very unwise law, prohibited the export of woollen goods, and permitted that of unwrought wool.

The land-owners of England were slow in discovering that their own prosperity was connected with that of the manufacturing interest. Their avowed object in legislation was to keep up the high price of the raw material, the wool grown upon their estates; and they had the honesty to say so in the preamble to a statute (14 Rich. II. c. 4) prohibiting any denizen of England from buying wool except from the owners of the sheep and for his own use.* This of course closed the home-market; the grower in his anxiety to grasp the profits of the wool-merchant and retailer in addition to his own,

* Por meutz garder le haut pris des layns.

found that he had turned off his best customers; and we learn from a contemporary historian that the growers were reduced to the greatest distress by having the accumulated stock of two or three years left on their hands.

In the reign of Henry VI., not more than a century after its introduction, the woollen manufacture had thriven so well, that it was made to contribute to the revenue, and we were enabled to compete with the nations by whom we had been taught it, on equal terms: a reciprocity law, passed at this time, ordains, that "if our woollen goods were not received in Brabant, Holland, and Zealand, then the merchandise growing or wrought, within the dominions of the Duke of Burgundy, shall be prohibited in England under pain of forfeiture." But there was already a growing jealousy between the landed and manufacturing interests, caused by the rise in the price of labour, resulting from increase of employment; for so early as the reign of Henry IV. an act was passed "that no one should bind his son or daughter to an apprenticeship, unless he was possessed of twenty shillings." This attempt to limit the supply of labour in manufacture would have wholly destroyed the woollen trade, had not the first monarch of the house of Tudor granted an exemption from the act to the city of Norwich, and subsequently to the whole county of Norfolk.

The besetting error of legislators in this age was the belief, that gold and silver had some inherent and intrinsic value in themselves, independent of their exchangeable and marketable value. They could not understand that the very essence of all commerce is barter, and that money only serves as a third term or common measure for ascertaining the comparative value of the articles to be exchanged. Ignorant of this fact, which, by the way, is not universally understood at the present day, they made several attempts to compel foreigners to pay for English goods in money. In 1429, a law was passed, that no Englishman should

sell goods to foreigners except for ready money, or other goods delivered on the instant.

This was such a fatal blow to trade that, in the very next year, the parliament was compelled to relax so far as to admit of the sale of goods on six months' credit. With equal wisdom and for the same perplexing reason, "the prevention of the exportation of treasure out of the country," a law was passed prohibiting "foreign merchants from selling goods in England to any other foreigner." This precious piece of legislation did not, of course, prevent the exportation of the precious metals, but it prevented the import of merchandise and of bullion, a result which quite perplexed the legislature, but did not lead to the abolition of the foolish law.

A second source of perplexity to the parliament was the question of wages, and, as if our ancestors had chosen to anticipate modern nonsense, they actually connected the question of wages with the question of food. As no branch of human industry has suffered so much from this stupid identification of matters which have no common element,—and the joining of which in one discussion is infinitely more absurd than the inquiry "Which is more distant, Christmas-day or the corner of Westminster-bridge?"—it will be necessary to explain, very briefly, the laws by which wages are regulated, and to show their complete independence of ordinary legislation.

The price of labour, as of everything else, is regulated by demand and supply: "If two masters are looking for a man, labour will be dear,—if two men are looking for a master, labour will be cheap." In order, therefore, to sustain the rate of wages, it is necessary not only to maintain the existing demand for labour, but, also, to open new sources of employment proportionate to the increase of population. To render this more clear, let us see what are the funds out of which wages are paid. No one but a downright idiot will even pretend to believe that they *can* be paid out of any fund but *profits*. To compel a person to pay wages out of capital, must

either drive him out of business, or reduce him to bankruptcy. Into any business where profits are large many men will eagerly enter, and the competition between the employers will create a demand for the labour of the employed, by which, and by which alone, the price of their labour, or, in other words, the rate of their wages, can be permanently enhanced. This reasoning, sufficiently obvious "to babes and sucklings," was incomprehensible to the parliament of 1349 (23 Edward I.). A pestilence had swept off great numbers of the working classes; the number of labourers being diminished while the amount of employment remained the same, the price of labour, that is "wages," consequently rose, and the legislature, then composed exclusively of landholders, enacted "that persons of the class of labourers should be compelled to serve for seven years, at no higher rate of wages than that which had been paid three years before." It appears from the frequent renewals of this statute, that labourers, knowing their own value in the market, paid less regard to the desires of employers, than to what one of the re-enactments calls "their singular ease and covetise;" it was, at length, discovered that this precious law defeated its own object; the labourers stood out as the superabundance of demand enabled them to do, and obtained more by private bargain than they would, probably, have done by legal contract.

Edward's parliament attempted to fix a price for wages; but even they did not attempt the more monstrous folly of fixing the price of food. They ordained, indeed, that all "dealers in victual should be bound to sell the same for a reasonable price." In fact, the parliament of 1390 (13 Rich. II. St. i. ch. 8) had the good sense to perceive, that the fixing of the price of provisions was a matter beyond legislative control. They even discovered, that cheap food was likely to produce high wages, for the very plain reason that the less a man expends in food, the more he has to spare for the purchase of clothing; and the more clothing is in demand,

the greater will be the demand for the labour of those employed in the production of cloth, and, consequently, the higher will be their wages. Had matters stopped here the barons would never have interfered; but the demand for manufacturing labourers called off a great number of agricultural labourers; they were thus obliged to raise the wages of those employed in the culture of their estates, and, to save this expenditure, they set forth an enactment, which, starting from an immutable truth, proclaimed as much of absurdity as could be found in any document save one, which would contradict the only aphorism of common sense which Richard's barons were able to discover. In this statute it is ordained, that "*Forasmuch as a man cannot put the price of corn and other victuals in certain,* the justices of peace shall every year make a proclamation, by their discretion, according to the dearth of victuals, how much every mason, carpenter, tiler, and other craftsmen, workmen, and labourers by the day, as well in harvest, as in other times of the year, after their degree, shall take by day, with meat or drink, or without meat and drink, and that every man obey to such proclamations from time to time, as a thing done by statute." It was absurd to attempt fixing the price of labour to any certain rate by statute; but what even these legislators had forborne to attempt as still more exquisitely absurd, "putting the price of corn and other victuals in certain," has been attempted in acts of parliament, which still hold a place in the statute-book. It was necessary to cast a glance at commercial legislation to account for the slow progress which the textile manufactures of England made under the Plantagenets. The termination of the wars of the Roses was marked by a new era: the Tudors obtained the crown against the will of the older aristocracy, and they felt it necessary to raise up some power as a counterpoise to the baronial feudalism. The relaxation of "the statute of labourers," and the exemption granted from "the statute of apprentices,"

were amongst the earliest of the beneficial changes made under the new dynasty.

Henry VII. removed a still greater check to industry, by restraining the usurpations of corporations. A law was enacted, that corporations should not pass by-laws without the consent of three of the chief officers of state; they were also prohibited from exacting tolls at their gates. The necessity of legislative interference was proved by the conduct of the corporations of Gloucester and Worcester, which had actually imposed transit tolls on the Severn—these, of course, were abolished. But the monarch was not superior to the prejudices of his age; he affixed prices to woollen cloths, caps, and hats, which, of course, led to a deterioration of the several articles. Yet this law was highly extolled as a master-stroke of policy by the statesmen of the day.

The parliaments in the reign of Henry VIII. were too busily engaged in enforcing the king's caprices, by inconsistent laws against heresy and treason, to pay much attention to trade and commerce. One circumstance, however, connected with the woollen trade deserves to be noticed. So greatly had our woollen manufactures increased, that the Flemings, no longer able to compete with the English as producers, entered into the carrying trade, bought the English commodities, and distributed them into other parts of Europe. In 1528 hostilities commenced between England and the Low Countries; there was an immediate stagnation of trade; the merchants having no longer their usual Flemish customers, could not buy goods from the clothiers; the clothiers in consequence dismissed their workmen, and the starving operatives tumultuously demanded "bread or blood." Shakspeare, whose father was a woolstapler, and who therefore perhaps had heard, traditionally as well as historically, of the sufferings of the clothiers, makes it a ground of charge against Wolsey, though he assigns another cause—

> The clothiers all, not able to maintain
> The many to them 'longing, have put off
> The spinsters, carders, fullers, weavers, who,
> Unfit for other life, compell'd by hunger,
> And lack of other means, in desperate manner
> Daring the worst to the teeth, are all in uproar,
> And danger serves among them.
>
> *Henry VIII.* Act i. sc. 2.

Wolsey scarcely knew how to account for these riots; he tried force with the workmen, but hunger was stronger than the law; he threatened the clothiers unless they gave employment, but wages could not be paid from empty purses; at length he sent for the merchants, and commanded them to buy cloth as usual! The merchants replied, that they could not sell it as usual; and, notwithstanding his menaces, would give no other answer. At length the true remedy was discovered; an agreement was made that commerce should continue between the two states even during war.

In the reign of Edward VI. an act was passed, by which every one was prohibited from making cloth, unless he had served an apprenticeship of seven years; this law was repealed in the first year of Queen Mary, as the preamble of the act states, "because it had occasioned the decay of the woollen manufactory, and had ruined several towns." It was, however, subsequently restored by Elizabeth.

The persecution of the Protestants in France, but more especially in Flanders, drove many eminent manufacturers to seek refuge in England, where they were graciously received by Elizabeth. She passed an act relieving the counties of Somerset, Gloucester, and Wiltshire from the old oppressive statutes, which confined the making of cloth to corporate towns; and trade, thus permitted to choose its own localities, began to flourish rapidly. In a remonstrance of the Hanse Towns to the diet of the empire, in 1582, it is asserted that England exported annually about 200,000 pieces of cloth. In this reign, also, the English merchants, instead of selling

their goods to the Hanseatic and Flemish traders, began to export themselves; and their success so exasperated the Hanse Towns, that a general assembly was held at Lubeck to concert measures for distressing the English trade. But the jealousy of foreigners was far less injurious to British commerce than the monopolies which Elizabeth created in countless abundance. An attempt, indeed, was made to remove one monopoly; but the experiment was not fairly tried, and its consequent ill success was used as an argument against any similar efforts. By an old patent, the Company of Merchant Adventurers possessed the sole right of trading in woollen goods. This monstrous usurpation of the staple commodity of the kingdom was too bad even for that age of darkness, and Elizabeth opened the trade; but the Merchant Adventurers entered into a conspiracy not to make purchases of cloth, and the queen, alarmed at the temporary suspension of trade, restored the patent.

In the reign of James I. it was calculated that nine-tenths of the commerce of the kingdom consisted in woollen goods. Most of the cloth was exported raw, and was dyed and dressed by the Dutch, who gained, it was pretended, 700,000*l.* annually by this manufacture. The king, at the instigation of Cockayne and some other London merchants, issued a proclamation prohibiting the exportation of raw cloths; the Dutch and Germans met this piece of legislation by prohibiting the importation of English dyed cloth; the consequence was, that our export trade was diminished by two-thirds, and the price of wool fell from seventy to eighty per cent. The king was forced to recall his proclamation. In the year 1622 a board of trade was erected, as the commission states, "to remedy the low price of wool, and the decay of the woollen manufactory." It is recommended to the commissioners to examine "whether a greater freedom of trade, and an exemption from the restraint of exclusive companies, would not be beneficial." A gratifying proof of the progress of intel-

ligence; but, unfortunately, it led to no practical result.

English commerce increased greatly under the Commonwealth, because no regard was paid to the prerogative whence the charters of the exclusive companies were derived, and because the progress of democratical principles led the country gentlemen to bind their sons apprentices to merchants. But with the Restoration came the old rage for prohibitions and protections; two thousand manufacturers from Warwickshire, and a great number from Herefordshire, emigrated to the Palatinate; and, in 1662, the Company of Merchant Adventurers declared, in a public memorial, that the white-clothing trade had abated from 100,000 pieces to 11,000! In 1668, however, some Walloons were encouraged to introduce the manufacture of fine cloths, from Spanish wool only, without the admixture of any inferior wool; but the progress of this branch of trade was very slow, owing chiefly to our municipal laws, which pressed heavily on foreigners.

It could not be asserted that the slow progress of the woollen manufactory was owing to any want of legislative protection, the exportation of wool, facetiously called *owling* in our old laws, because it was principally carried on during the night, was prohibited by many severe statutes. One, passed in the reign of Elizabeth, makes the transportation of live sheep, or the embarking them on board any ship, "for the first offence, forfeiture of goods, and imprisonment for one year, and that at the end of the year, the left hand shall be cut off in some public market, and shall there be nailed up in the openest place; and the second offence is felony." And this statute is the more remarkable when contrasted with one then in force, by which it was enacted that "no person shall keep or have more than two thousand sheep, on pain to forfeit for every sheep above the number."

But severe as was Elizabeth's statute, it was ex-

ceeded by that of Charles II., which declared the exportation of wool a felony not to be set aside by royal licence! The extravagant severity of such a law defeated its purpose, and the penalty was subsequently changed into fine and imprisonment, but "fullers' earth was at the same time included in the list of prohibited articles."

But the legislature was not satisfied with securing a monopoly of materials to the woollen manufacturers, it deigned to give them instructions in their trade. Acts were passed for regulating the length and breadth of cloths; for enforcing the introduction of improved processes of manufacture; for securing efficient dyeing and colouring; and even for determining the mode in which they should be stretched and dried. Somehow or other manufactures were not one whit improved by the paternal care of the government; and parliament, in its wisdom, next proceeded to find customers for the manufactures over whose production it had watched so tenderly. Foreign cloths were prohibited; it was ordained that every man should wear English cloth, and, lest the living should not afford a sufficiency of custom, the dead were forced to contribute, a penalty being affixed to the interment of a corpse in any but a woollen shroud!

All these privileges and protections, bad enough in themselves, were tenfold worse in their consequences. The wool-grower, robbed of his foreign market, demanded and obtained protection in the market at home. The manufacturers, secured from competition, made no attempt to improve the processes of workmanship; English cloth had long lost its fame in Europe, and "the staple manufacture" would have probably died a natural death had not a market been secured in our increasing American and West India colonies. But then came the American war, the monopoly of market was lost, and wool became a drug in the market; the best quality was to be bought for less than four pence per pound. Two pieces of good fortune saved our "staple

manufacture" from ruin; parliament did not interfere, and the example of the cotton manufacturers induced the wool traders to direct their attention to machinery. Since that period the manufacture has been gradually emancipated from legislative trammels, and, instead of being wholly ruined, as seemed all but certain in 1782, our exports of woollen cloth average between 6 and 7,000,000*l.* in value.

The linen trade was at this time little valued in England, and as a proof of the contempt in which it was held, we find that the English parliament generously made a present of it to the people of Ireland, though they addressed William III. to discourage by all possible means the woollen manufactures of that country, and ordered a petition from the people of Aldborough, in Suffolk, and Folkstone, in Kent, to be taken into serious consideration, which stated, as a grievance, the loss they sustained "by the Irish catching herrings at Waterford and Wexford, and sending them to the Straits (the Spanish coast), and thereby forestalling and ruining your petitioners' markets." It would not be easy to find a parallel for the commercial jealousy which represented it as a grievance that the Irish should catch and cure their own fish; we may be assured that they who considered such a petition worthy of serious attention would not have surrendered the linen manufacture to Ireland, had they believed that it could be conducted with any reasonable hope of profit in England.

Many circumstances contributed to render the linen trade limited and precarious in Ireland. The people, except in Ulster, were little acquainted with flax, nor could they otherwise than slowly, in a course of years, acquire dexterity in a new trade. The preparation of the flax is delicate and precarious; the importation of the seed a heavy expense where there were few capitals invested in business; the crops were very liable to failure, and the culture was generally found to be so unprofitable, that, notwithstanding large sums lavished in pre-

miums by the Irish parliament for its promotion, the farmers, who made a full trial of its fruits, soon abandoned it for ever. To this must be added the stedfast refusal of the bishops and clergy in the south of Ireland to accept an equitable modus in lieu of the tithe of flax. Legislative protection in the shape of premiums and bounties aggravated the evil it was designed to cure; the trade, wherever it was at all sound, was fostered into unhealthiness, and but for the introduction of machinery, from the example of the cotton manufacture, it would have been long since utterly annihilated. Bounties were granted on the exportation of linen down to the year 1830; and thus more than a century had elapsed before legislators discerned the folly of supplying foreigners with manufactures at less than their first cost. The only real and effectual legislative encouragement which the manufacture has ever met with has been the reduction of the duties on flax and hemp, and the relinquishing of the absurd attempt to force their growth at home.

Woollen and linen manufacturers having been long the staple trades of Great Britain, their history may be said to be identified with the progress of industry in the country. Silk and cotton manufactures were imported branches of industry, and it will therefore be necessary to devote some attention to their history before they became established in England. And here it may be necessary to state, that the principles of weaving are nearly the same whatever may be the nature of the filaments employed; but that there are great varieties in the process of spinning, arising from the different length of the staple or fibre in the raw material; silk, for instance, can scarcely be said to be spun, for the elongation of the threads is effected by the silkworm, and the doubling or twisting of these threads is more properly denominated throwing. The short loose fibres which are cleaned off from the proper silk thread are indeed spun, by processes similar to those used in spinning tow, which is a similar refuse from the fibres of flax. It will

therefore be convenient to give some account of silk and cotton separately, before we enter on the history of that unrivalled series of mechanical inventions, which, beginning with cotton, have extended themselves with no alteration of principle, though with considerable difference of detail, to all the textile fabrics of Britain.

CHAPTER V.

SPECIAL HISTORY OF THE SILK MANUFACTURE.

SILK is a fine glossy thread or filament spun by various species of caterpillars of the genus *phalæna*; it is the substance which the animal spins to protect itself when in the *pupa* state, and the life of the animal must be destroyed in order to obtain the cocoon, or ball of silk, uninjured. Mr. G. R. Porter thus eloquently directs attention to the enormous expenditure of insect life by which this article of luxurious clothing is obtained:

"The quantity of silk material used in England alone, amounts in each year to more than four millions of pounds' weight, for the production of which myriads upon myriads of silk-worms are required. Fourteen thousand millions of animated creatures annually live and die to supply this little corner of the world with an article of luxury! If astonishment be excited at this fact, let us extend our view into China, and survey the dense population of its widely-spread region, whose inhabitants, from the emperor on his throne, to the peasant in the lonely hut, are indebted for their clothing to the labours of the silk-worm. The imagination, fatigued with the flight, is lost and bewildered in contemplating the countless numbers which every successive year spin their slender threads for the service of man."

Silk was known in Europe long before the mode of its production; it was brought by caravans from China, and received its Latin name, *Sericum*, from the *Seres*, who are supposed to have been the ancient inhabitants of the Chinese Empire. Various erroneous opinions were entertained respecting its origin, and some critics have imagined that Virgil mistook it for cotton when he says

> The distant Seres from their trees who cull
> The filmy fleeces of a wondrous wool.—*Georgics.*

But Père du Halde has described a species of silk of which he first communicated the knowledge to modern nations, quite consistent with the description given by the poet.

The notices already given of the trade of Cos show that silk was early imported by the Greeks; but it was not introduced amongst the Romans until the later ages of the republic. It is recorded as a proof of the vast expense of the magnificent spectacles with which Julius Cæsar sought at once to dazzle and conciliate the populace, that he decorated the actors in his varied pageants with a profusion of silk dresses, which were viewed by the Italians with equal wonder and admiration. In consequence of the difficulties of transit, the vast length of desert which the caravans had to traverse, and, probably, the limited supply of silk in China itself, this article bore a very high price in Rome, and was often sold for its weight in gold. Silken dresses were esteemed too expensive and delicate for men, and were appropriated wholly to ladies of eminent rank and opulence. In the beginning of the reign of Tiberius a law was passed enacting, "that no man should disgrace himself by wearing a silk dress." This might, however, have been a religious as well as a sumptuary ordinance, for it is a singular circumstance in the history of silk, that, on account of its being the excretion of a worm, several religious bodies in the East, but more es-

pecially the Mohammedans, consider it an unclean dress. Indeed, it has been decided by the unanimous consent of all the Sonnite doctors, that a person wearing a garment made entirely of silk, cannot offer up the daily prayers enjoined by the Koran.

The profligate and effeminate Heliogabalus was the first of the Roman emperors who wore a garment entirely of silk; and, in consequence of his example, the custom of wearing silk soon became general among the wealthy citizens of Rome, and even extended to the provinces. It seems probable, also, that the price of the article had diminished in consequence of its beginning to be imported by the maritime route through Alexandria, instead of by caravans through the arid deserts of Tartary and Turkestan. Chinese histories inform us, that an ambassador from one of the Antonines came to their remote country for the purpose of concluding a commercial treaty, and this is rendered highly probable by the fact that oriental commodities became both plentiful and cheap under and after their dynasty. Ammianus Marcellinus informs us, that in his age (A.D. 370) silk was generally worn even by the lower classes.

After the restoration of a native dynasty in Persia under the Sassanides, and the establishment of the Eastern empire at Constantinople, a long series of wars ensued between the Persian sovereigns, who deemed themselves legitimate inheritors of the power of Cyrus, and the Byzantine emperors who wished themselves to be considered successors of Alexander the Great. The command of the sea of Oman gave the Persians a decided advantage over the Egyptian merchants, who were forced to import oriental commodities by the tedious and dangerous navigation of the Red Sea. Until the introduction of steam-navigation the Red Sea, or *Yam Suph*,* as it is called by the Orientals, was universally dreaded by voyagers. The strait at its entrance

* That is "the Sea of Weeds."

was significantly named by the Arabs *Bab-el-Mandeb*, or, "the gate of tears," and it was a common proverb with eastern sailors, "Yam-Suph is a double-locked sea; there are six months in the year that you cannot get into it, and six more that you cannot get out of it." But the Persians were not satisfied with this natural superiority; having it in their power to molest or cut off the caravans, which, in order to procure a supply for the Greek empire, travelled by land to China through the northern provinces of their kingdom, they laid such onerous transit duties on foreign merchants, that the Greeks were forced to abandon this branch of commerce and purchase their silk from the Persians and Sogdians. These, with the usual rapacity of monopolists raised the price of silk to such an exorbitant height, that the Greek manufacturers, whose looms depended on a supply of this raw material, were thrown out of employment and nearly ruined.

The emperor Justinian, eager, not only to obtain a full and certain supply of a commodity which was become of indispensable use, but solicitous to deliver the commerce of his subjects from the exactions of his enemies, endeavoured, by means of his ally the Christian monarch of Abyssinia, to wrest some portion of the silk trade from the Persians. In this attempt he failed; but when he least expected it, he, by an unforeseen event, attained his great object of procuring his subjects an abundant supply of silk, independent both of ships and caravans.

Two Persian monks having been employed as Christian missionaries by some of the churches which had been established in India, pursued their evangelical labours until they had penetrated into the remote country of the Seres, or Chinese. (A.D. 551.) There they observed the labours of the silk worm, the mode in which these animals were fed on the mulberry leaf; the care bestowed upon them in the several periods of insect transformation, and the attention necessary to ob-

taining perfect cocoons. Without such knowledge, the mere possession of the insects would have been useless; for the time that elapses while the silk-caterpillar is undergoing its changes, varies according to the temperature and the quantity of nourishment with which it is supplied; the health also of the insect and the subsequent perfection of the silk depend upon the mode in which these changes are made, and the intervals between the successive moultings of the skin, which take place before the animal attains its full growth. The Chinese calculate that the same number of insects which would, if they had attained the full size in twenty-three or twenty-four days, produce twenty-five ounces of silk, would produce only twenty ounces if their growth occupied twenty-eight days, and only ten ounces if forty days. In order, therefore, to accelerate their growth, they supply the insects with fresh food every half-hour during the first day of their existence, and then gradually reduce the number of meals as the worms grow older. It deserves to be remarked as an unnoticed fact in Natural Theology, that the substance on which this valuable caterpillar feeds, is the leaf of the Mulberry Tree; and Providence, as if to ensure the continuance of this useful species, has so ordained it, that no other insect will partake of the same food; thus ensuring a certain supply for the little spinster.

Not only does the supply of food require great care and attention, but numerous precautions are necessary to keep them clean and warm. Some notion of the extent of the care required may be formed from the following extract from a very ancient Chinese work on the culture of silk:

"The place where their habitation is built must be retired, free from noisome smells, cattle, and all noises; a noisome smell, or the least fright, make great impressions upon so tender a breed; even the barking of dogs and the crowing of cocks are capable of putting them in disorder, when they are newly hatched.

"For the purpose of paying them every attention an affectionate mother is provided for the worms, who is careful to supply their wants; she is called *Isan-mon*, mother of the worms. She takes possession of the chamber, but not till she has washed herself and put on clean clothes, which have not the least ill smell; she must not have eaten anything immediately before, or have handled any wild succory, the smell of which is very prejudicial to these tender creatures; she must be clothed in a plain habit, without any lining, that she may be more sensible of the warmth of the place, and accordingly increase or lessen the fire, but she must carefully avoid making a smoke or raising a dust, which would be very offensive to these tender creatures, which must be carefully humoured before the first time of casting their slough. Every day is to them a year, and has, in a manner, the four seasons; the morning is the spring, the middle of the day the summer, the evening the autumn, and the night the winter."

The intelligent author to whom we are indebted for the preceding translation, furnishes us with the following details respecting the Chinese mode of managing the worms and reeling the silk from the cocoons; they do not differ in principle from those which are used in the western world—the superiority of European silk arising altogether from more scientific arrangements and more perfect machinery.

While it remains in the state of a caterpillar, the Silk-worm changes its coat four times, and previous to each moult refuses its food and appears in a very sickly condition. As soon as its nest or cocoon is finished, and it is changed into the pupa state, the cocoons are carefully removed from the place where the animal had formed them; and after those which it is intended to keep, that they may perfect their changes and lay eggs for the ensuing year, are removed, the remainder are placed in large vessels, each covered with a thick blanket; they are then exposed to heat sufficiently

powerful to destroy the life of the pupæ. This is generally accomplished by placing the vessels in an oven, heated to about the same degree as that of a baker after his loaves are drawn; here they are suffered to remain for about an hour, they are then withdrawn, but the blanket that covers them is not removed for the space of five or six hours.

"The first process in preparing the silk, is winding it off the cocoons: for this purpose, after the rough outsides are removed, several handfuls at a time are thrown into a vessel containing water, and placed over a gentle fire, the water is then allowed to be heated to nearly the boiling point; a short stunted brush formed of heath, or any other shrub of that description, is now gently moved about among the cocoons, and, on withdrawing it from the water, the ends of the silk are found to have adhered to it in several places; the winder then gathers together, with her fingers, as many ends as she intends the first description of thread to consist of, and hands them to an assistant, whose office it is to turn the reel as soon as the silk is laid upon it; the principal workwoman, in the mean time, continually adds to the thread the ends of fresh cocoons, as soon as the first are exhausted."

Having made themselves acquainted with these particulars, the monks repaired to Constantinople, and revealed the information which they had acquired to the Emperor Justinian. Encouraged by the liberal promises of that monarch, they undertook to bring to his capital a sufficient number of those wonderful insects to whose labours man is so much indebted. They proceeded to China, and finally accomplished the object of their mission by obtaining a competent supply of the eggs of the silkworm, which they concealed in a hollow cane. Having returned safe to Constantinople, the eggs were, under their direction, hatched by the artificial heat of a dunghill, and the insects were fed on the leaves of the wild-mulberry tree. Such care was bestowed upon

them, that they soon multiplied, and worked in the same manner as in those climates where they first became the objects of human attention and care.

The cessation of the demand for silk from the Roman empire exceedingly perplexed the nations of Central Asia, and in the reign of Justin II., the successor of Justinian, a Sogdian embassy was sent to Constantinople for the purpose of renewing and extending ancient commercial treaties. To their surprise and dismay, they found that the culture of silk had made such progress as to render Constantinople quite independent of foreign supplies; and they were forced to confess that the Byzantines, or, as they called them, the Romans, were not inferior to the natives of China either in the management of the insects, or the manufacture of the silk.

Greece, but more especially the Peloponnesus, continued for several centuries to be the great silk-farm of Europe; indeed, it was from the abundance and excellence of its mulberry-trees that the southern peninsula of Greece received the name of the Morea. Silk-weaving was carried to a pitch of excellence unknown before in the looms of Thebes, Corinth, and Argos; an enlightened government alone was wanting to restore the pristine splendour of these celebrated cities, and perhaps to render Greece the parent of ancient, as it had been of modern civilisation. But the Byzantine empire—exhibiting through the long career of its dishonoured existence one unvarying picture of perfidy and profligacy triumphant in the palace,—ferocious bigotry, based at once on enthusiasm and hypocrisy, ruling in the Church,—civil dissensions, equally senseless and bloody, distracting the State,—complete demoralization pervading every rank of society from the palace to the cottage—could only produce and did only produce

> Nations of slaves by tyranny debased,
> Their Maker's image more than half effaced.

Greece preserved an undisturbed monopoly of the

silk trade in Europe until the 12th century. But in the year 1147, Roger, one of the Norman pirates who founded dynasties in the south, after acquiring the kingdom of Sicily, began to sweep the shores of the Mediterranean with his corsairs. Greece, helpless from the demoralization of its inhabitants, and left defenceless by a government, which simply to call feeble would be sadly to overrate its strength, was a tempting prey to the plundering Normans. Roger sacked Corinth, Athens, and Thebes, carrying off vast numbers of the inhabitants captive to Palermo; the captives could support themselves in a foreign land only by attending to their accustomed branch of industry; and thus, by their means, the culture of the worm and the manufacture of silk were introduced into Sicily. From this island the art spread into Italy; and Venice, Milan, Florence, Genoa, Lucca, &c., were soon distinguished for their success in raising silkworms, and for the extent and beauty of their manufactures of silk.

In 1480, the silk-manufacture was established in France, Louis XI. having invited workmen from Italy, who located themselves at Tours. The manufacture was not begun at Lyons until 1520, when Francis I., having got possession of Milan, prevailed on some of the Milanese artisans to establish themselves at Lyons under his protection. They were not unwilling to quit Italy, which was then the battle-field of Europe, as Flanders was in a later age, and they profited by their security so much, that the silks of Lyons very soon not only rivalled but surpassed the finest productions of the Italian loom. Nearly at the same period, the rearing of silkworms began to be successfully prosecuted in Provence, and other parts of the south of France. Henry IV. rewarded such of the early manufacturers as had supported and pursued the trade for twelve years with patents of nobility. "Great part of the letters," says Sully, "I received from this prince turned upon his buildings, those of his new silk-manufactures especially,

which he still carried on with great ardour;* his greenhouse in the Tuileries was the place he set apart for breeding the silkworms, the eggs having been sent him from Spain, and he hastened the building of it for that purpose. I laid, by his order, the foundations of the new edifices for his tapestry-weavers, in the horse-market, which requiring a larger extent of ground than could be procured, without encroaching a little upon a garden belonging to Montmagny, who opposed it strongly, the king ordered that he should be paid the sum he demanded for his ground, representing to him, however, that on such an occasion, when the public utility was in question, an individual ought to waive the consideration of his own particular interest. His majesty sent for Comans and La Planche from other countries, and gave them the care and superintendence of these manufactures."

Several abortive efforts have been made to introduce the rearing of silk-worms as a profitable branch of industry into England, and more recently into Ireland. The reasons of the failure of such projects appear to be the coldness and moistness of the climate, the lateness of the season when the mulberry puts forth its leaves, the difficulty of training persons to the delicate management and manipulation which the worms require, and above all the want of anything like a scientific education amongst the operative classes of the population, and indeed amongst many of those who rank as employers. The silk-growers of Provence are well acquainted with the use of the thermometer and hygrometer; they are therefore able to keep under regular control the artificial climate in which the worms pass their existence, and to change the degrees of temperature and moisture as the exigencies of insect-life may require. It needs not to be remarked how few English labourers there are who know

* From contemporary writers we find that a manufacturer of Provence named Lerran, attempted about this time to make stuffs from the finest parts of the bark of the mulberry tree.

any thing about the most simple forms of philosophical apparatus. It is indeed doubtful whether the production of raw silk would ever become lucrative in England; but the finest cocoons which we have ever seen were exhibited by Mr. Felkin, the well-known statistician, of Nottingham, having been spun by some worms belonging to him, in that town. From some experiments made by ourselves, many years ago, we should conclude that the success of such attempts depends very much on the species of silk-caterpillar selected. It is exceedingly probable that some species of the *phalæna* may be more easily acclimated than others, and may also perhaps be fed on other than mulberry leaves.

The silk manufacture seems to have been introduced into England early in the fifteenth century, but it did not make much progress until the age of Elizabeth. The tranquillity of her long reign, and the influx of Flemings, occasioned by the disturbances in the Low Countries, gave a powerful stimulus to the manufactures of England, and several establishments for throwing silk were formed in the metropolis. Before, however, we proceed further with the history, it will be necessary to explain the terms applied to the different kinds of silk used in commerce.

Raw silk is the original thread produced by the worm, wound off the cocoon by means of a reel so as to form one continuous thread. In order to facilitate this operation, the cocoons are immersed in hot water to soften the glutinous matter or natural gum by which the filaments are held together. Several cocoons are usually wound off together on the reel, from which the thread is taken when dry, and made up into hanks.

A single filament, or thread, being twisted so as to give it more strength and consistency, receives the collective name of *singles*.

Tram is formed of two or more threads twisted together. In this state it is employed in weaving, forming the *shoot*, or weft.

Thrown silk is analogous to the warp-yarn in the cotton manufacture; it is formed of two, three or more singles, according to the substance required, twisted together in a *contrary* direction to that in which the singles of which it is composed are twisted. This process is frequently denominated *organizing*, and the silk so produced is termed *organzine*. The art of throwing silk was originally confined to Italy, but in the fifth year of Elizabeth's reign, the English, according to Stow, "gained it from the strangers." The silk-throwsters of London were united into a fellowship as early as 1562, and were incorporated as a chartered company in 1629. Though retarded by the civil wars, the manufacture steadily advanced; and so flourishing had it become, that, in 1666, an act of parliament states, that no fewer than forty thousand persons were engaged in the trade. It did not quite escape the curse of protection which came so rapidly into fashion under the reign of the Stuarts, and which, like the hug of the bear, however affectionately intended, is fatal to all that it embraces. But from various causes the prohibitions on foreign silks were not strictly enforced, and the importation was practically free.

The Revocation of the Edict of Nantes drove several hundred thousand of the most industrious of the French into exile; fifty thousand at least settled in England, and at a later period several thousands more migrated to Ireland. These exiled Protestants had "suffered persecution without learning mercy;" too many of them became zealous advocates of a system of exclusive laws, precisely similar to those from which they had themselves suffered most severely. In the interval between 1685 and 1692, the importations of foreign silks into England had exceeded half a million annually in value, and it was during this very period that the British manufacture, exposed to free competition, made the most rapid advance. But in 1697, the parliament, influenced by the petitions of the French Huguenots who had settled in Spitalfields, and perhaps also by the popular outcry

against France and Popery, passed an act prohibiting the importation of French and all other European silk-goods, which, in 1701, was extended to the silks of India and China. To complete the system, an act was passed in 1722, granting bounties on the export of silks for the three ensuing years.

The silk-throwsters of Italy were at this time unrivalled in Europe, on account of the superior machinery they employed, and on them the English weavers chiefly depended for a supply of organzine. In 1715, Mr. Thomas Lombe, whose brother John had visited Italy to become acquainted with the processes and machinery of the silk-throwsters, obtained a patent for the exclusive property in the famous silk-mill which he began to erect in Derby, from the models clandestinely obtained in Italy. To procure these models, John Lombe, disguised as an humble operative, had gone to work in one of the Italian mills, and, in consequence of his apparent destitution, had obtained permission from the proprietors to sleep in the edifice. He employed his nights in making drawings and working models of the machinery which he contrived to bring in safety to England.

The mill erected at Derby came nearer to the idea of a factory of the present day than any previous establishment of the kind. The machine, according to the statement in which Sir Thomas Lombe set forth his claims to the national gratitude, had 97,746 wheels, movements, and individual parts, working day and night; all of these received their motion from one large water-wheel, and were governed by one regulator; and it employed three hundred persons to attend and supply it with work. During the fourteen years which the patent endured, the Lombes did not derive the profit expected from their enterprise—their failure was in some measure caused by the prohibition which the king of Sardinia laid on the export of raw silk,—they petitioned parliament for a renewal of their patent, which was refused, but fourteen thousand pounds were voted to them as a compensation.

Throwing-mills were now erected in various parts of England; and to encourage capitalists to invest money in this new branch of industry, heavy duties almost, if not altogether, amounting to prohibition, were imposed on the importation of organzine silk. The silk-weavers of Spitalfields, who were thus compelled to buy a worse material of their manufacture at a higher price, could not venture to complain, for they had led the way in asking for prohibition of foreign imports; and the silk-throwsters who, misled by the specious promise of protection, had invested their capital in mills, took little care to provide perfect machinery, and, having once made their outlay, set their faces decidedly against all improvement.

The natural consequences of such a system followed; British silks were the worst and dearest on the face of the earth; French fabrics were smuggled into the country at a rate of half a million annually; and every change of fashion was followed by a series of bankruptcies, because the surplus of silks unconsumed at home could not be disposed of profitably abroad. From 1719 to 1826, the history of the silk-trade offers nothing but complaints of the manufacturers against the import of foreign silks, countless acts of parliament to exclude them, and combinations and outrages on the part of the workmen. It was not to be expected that the operatives should be wiser than their masters; it was not one whit more absurd for the workmen to expect the rate of wages to be kept up irrespective of the profits on the article manufactured, than for the masters to expect the rate of profits to be kept up irrespective of the competitive value of the articles sold. It was utterly useless for legislators to pass laws securing to domestic manufactures, which were both bad and dear, the monopoly of the home-market; the legislators themselves following the natural law of commerce, to buy the best things at the cheapest rate, were notoriously purchasers of contraband goods

and in one of the debates on the policy of these prohibitory duties, it was stated and not contradicted, that every member in the house, of course including those most violently opposed to the repeal, had a smuggled silk handkerchief in his pocket!

Such a system of trade was ruinous to all engaged in it, but to none more than the unhappy operatives. The cry, or, rather, the clamour, of distress has alarmed and excited the metropolis annually for more than half a century. Parliament, in its wisdom, did not once interfere in behalf of the operatives, and produced a statute which of itself was quite sufficient to destroy the most prosperous trade that ever existed. This precious specimen of legislative wisdom which left even the old "statute of labourers" far behind in its excess of commercial absurdity, was called the Spitalfields' Act of 1773; it ordained, that the weavers of the county of Middlesex should be entitled to demand a fixed price for their labours, to be settled by the magistrates, that neither men nor masters should be permitted to vary from this legislative tariff, and it subjected the manufacturers to heavy penalties if they employed any but weavers of the district. It was of this statute that a celebrated economist, with equal severity and justice, said, "such a law would lead us to suppose that St. Stephen's sometimes interchanged denizens with St. Luke's."

Though manufacturers were prohibited from employing any but the workmen of the district, they were not compelled to remain with their capital in the district, nor to continue the investment of their money in an unprofitable trade. Many removed their business to Macclesfield, Manchester, Norwich, &c.; others quitted the silk-trade, and aided in the great substitution of fine cottons for silks, which commenced in 1785. The continental war, which suspended manufactures throughout Europe for nearly a quarter of a century, however, prevented the consequences of this impolicy from being so

immediately felt as they otherwise would have been; but, in 1815 and 1816, the Spitalfields' weavers were involved in distress, exceeding, both in its extent and severity, anything which had ever been felt at any former period. The misery thus produced was clearly produced by perverse legislation, and could not be relieved by any charitable expedient; it had, however, one beneficial result; the Spitalfields' Act was repealed in 1824; had it continued to the present day there would not have been employment in the metropolis for a single silk-weaver.

After the lapse of more than a century, the impolicy of the system by which the silk manufacture had been so long depressed became obvious to every intelligent individual, save those whose perceptions were blinded by a real or supposed interest in upholding the monopoly. Mr. Huskisson on moving for leave to bring in a bill for putting an end to the absurd system of legislative interference and legislative protection, (March 8th 1824,) observed, "The monopoly had produced what monopoly was always sure to produce, an indifference with regard to improvement. This useful zeal which gives life to industry, which fosters ingenuity, and which in manufactures occasions unceasing efforts to produce the article in the most economical form, had been comparatively extinguished. *To the prohibitive system it was to be ascribed, that in silk only, in the whole range of manufactures, we were left behind our neighbours!* We have here a proof of that chilling and benumbing effect which is sure to be produced when no genius is called into action, and when we are rendered indifferent to exertion by the indolent security derived from restrictive regulations. I have not the slightest doubt that, if the same system had been continued with respect to the cotton manufacture, it would have been at this moment as subordinate to the woollen as it is junior in its introduction to the country."

On the 5th of July 1826 the prohibitory system

ceased and determined; then and then only did the silk manufacturers begin to profit by the brilliant series of mechanical inventions which had raised the cotton-trade to its unrivalled greatness. Since then, the silk-trade has gone on steadily and progressively; affording to the nation the most decisive proof of the pernicious influence of Protection and the beneficial results of Free Trade.

Before passing to the history of the cotton manufacture, it will be necessary to notice two attempts which have been made to obtain silken filaments without having recourse to the cocoons of the silk caterpillar. Most observers of nature are aware that certain species of spiders, besides their ordinary webs, produce a small silky bag for the protection of their eggs. These bags may be often found in the corners of windows, under the eaves of houses, in hollow trees and in similar situations, which sagacious instinct leads the spider to select as protected from the wind and rain. The filaments which form these bags are much stronger and more durable in their texture than those which compose the ordinary spider's web. They are originally of a greyish colour but become nearly black by exposure to the air. In some experiments which we made some years ago we found, that they could be bleached by the aid of chlorine, and some which we had thus prepared were perfectly white.

About a century ago, a French gentleman, M. Bon, was induced to institute a series of experiments on the comparative merits of the silk-worm and the spider as silk-producing animals, and, from the enthusiasm with which men are led to regard and pursue every new discovery, was unconsciously led greatly to exaggerate the importance of the latter. Our experiments undertaken only for amusement in a College vacation had no other result than to sharpen our interest in M. Bon's investigations, with which we were not acquainted until long after the abandonment of our own imperfect research.

M. Bon, having first collected a large quantity of the spider-bags, tried various modes of manipulation, but found it impossible to reel the silken filament; he therefore resolved to treat it as a wool, and after various trials eventually adopted the following process.

Twelve or thirteen ounces of the bags were beaten with the hand or by a stick, until they were entirely freed from dust. They were next washed in warm water, which was continually changed, until it no longer became clouded or discoloured by the bags under process. After this they were steeped in a large quantity of water, wherein soap, salt-petre, and gum-arabic had been dissolved. The whole was then set to boil over a gentle fire, during three hours, after which the bags were rinsed in clear warm water, to discharge the soap. They were then set out to dry, during several days, and the carding operation was then performed, with cards differing from the usual sort only in being much finer. Thus was a peculiar ash-coloured silk obtained, which was spun without difficulty, which took readily all kinds of dyes, and might have been wrought into any kind of silken fabric. M. Bon had stockings and gloves made from it, some of which he presented to the Royal Academy of Paris, and others to the Royal Society of London.

The silk was affirmed by M. Bon to be stronger and finer than the common sort, and according to his statement, spiders were much more productive than silk-worms, and there were besides the following advantages relating to them: spiders hatch spontaneously, without any care, in the months of August and September, the old spiders dying soon after they have laid their eggs: the young ones live for ten or twelve months without food, and continue in their bags without growing, until the hot weather, by putting their viscid juices in motion, induces them to come forth, spin, and run about in search of food.

The only obstacle, therefore, to establishing a considerable manufacture from these spider-bags, that is, the diffi-

culty of obtaining them in sufficient abundance, was attempted to be obviated by breeding young spiders in convenient apartments on a large scale. M. Bon commissioned a number of persons to collect and bring to him all the short-legged spiders they could possibly obtain. These, as he received them, he enclosed in paper coffins, or in pots covered with papers, which papers, as well as the coffins, were pricked over their surface with pin-holes, to admit air to the prisoners. The spiders were duly fed with flies, and after some time it was found on inspection that the greater part of them had formed their nests. It was contended that these nests afforded much more silk in proportion to their weight than those of the silkworm, in proof of which it was asserted that thirteen ounces yielded nearly four ounces of pure silk, two ounces of which were sufficient to make a pair of stockings; whereas, stockings made of common silk weighed seven or eight ounces.

It was objected by some of M. Bon's contemporaries, that the spiders were venomous; and this is so far true that a bite from some of the species is very painful, and produces as much swelling as the smart sting of a nettle. M. Bon, however, asserted, that he was several times bitten, without experiencing any inconvenience; if so, he was more fortunate or less sensitive than any of the spider-tamers with whom we have been acquainted. But it was further asserted, that this venom extended itself to the silk which the spider produced, which was utterly absurd, as every one who has ever applied a cobweb to stop the bleeding from a cut ought to have known. M. Bon declared with perfect truth, that the silk, so far from being pernicious, had been found useful in staunching and healing wounds, its natural gluten acting as a kind of balsam. Willing to extract every possible good from his favourite [illegible] he subjected the spider-silk to chemical analy[illegible]ained from it a volatile salt. By preparing [illegible] manner adopted for the once celebrated

Guttæ Anglicanæ, he produced drops, which, as he believed, possessed yet greater efficacy: he called this preparation *Montpelier drops*, and prescribed its use in all lethargic diseases!!

The honest enthusiasm of the projector, and the singularity of a regular establishment being formed for rearing and working spiders, excited a considerable share of public attention. It was, indeed, an age of strange speculations, for nearly at the same time a German gentleman broached a scheme for turning tame squirrels and mice to account in spinning; and companies were formed in England, with large nominal capitals to carry out schemes still more preposterous. So important did M. Bon's project appear to the French Academy, that they deputed the eminent naturalist, M. Reaumur, to investigate the merits of this new silk-filament.

After a long and patient examination M. Reaumur stated the following objections to M. Bon's plan for raising spider-silk, which have ever since been regarded as insurmountable. In the first place, the natural fierceness of spiders renders them unfit to be bred together. On distributing four or five thousand of these insects into cells or companies of from fifty to one or two hundred, it was found that the larger spiders quickly killed and ate the smaller, so that in a short space of time the cells were depopulated, scarcely more than one or two being found in each cell. In the next place, the silk of the spider is inferior to that of the silkworm both in lustre and strength; and produces less material in proportion, than can be made available for the purposes of the manufacture. The filament of the spider's-bag can support a weight of only thirty-six grains, while that of the silkworm will sustain a weight of one hundred and fifty grains. Thus four or five threads of the spider must be brought together to equal one thread of the silkworm, and as it is impossible that these should be applied so accurately over each other as not to leave little vacant spaces between them, the lif-

any thing about the most simple forms of philosophical apparatus. It is indeed doubtful whether the production of raw silk would ever become lucrative in England; but the finest cocoons which we have ever seen were exhibited by Mr. Felkin, the well-known statistician, of Nottingham, having been spun by some worms belonging to him, in that town. From some experiments made by ourselves, many years ago, we should conclude that the success of such attempts depends very much on the species of silk-caterpillar selected. It is exceedingly probable that some species of the *phalæna* may be more easily acclimated than others, and may also perhaps be fed on other than mulberry leaves.

The silk manufacture seems to have been introduced into England early in the fifteenth century, but it did not make much progress until the age of Elizabeth. The tranquillity of her long reign, and the influx of Flemings, occasioned by the disturbances in the Low Countries, gave a powerful stimulus to the manufactures of England, and several establishments for throwing silk were formed in the metropolis. Before, however, we proceed further with the history, it will be necessary to explain the terms applied to the different kinds of silk used in commerce.

Raw silk is the original thread produced by the worm, wound off the cocoon by means of a reel so as to form one continuous thread. In order to facilitate this operation, the cocoons are immersed in hot water to soften the glutinous matter or natural gum by which the filaments are held together. Several cocoons are usually wound off together on the reel, from which the thread is taken when dry, and made up into hanks.

A single filament, or thread, being twisted so as to give it more strength and consistency, receives the collective name of *singles*.

Tram is formed of two or more threads twisted together. In this state it is employed in weaving, forming the *shoot*, or weft.

Thrown silk is analogous to the warp-yarn in the cotton manufacture; it is formed of two, three or more singles, according to the substance required, twisted together in a *contrary* direction to that in which the singles of which it is composed are twisted. This process is frequently denominated *organizing*, and the silk so produced is termed *organzine*. The art of throwing silk was originally confined to Italy, but in the fifth year of Elizabeth's reign, the English, according to Stow, "gained it from the strangers." The silk-throwsters of London were united into a fellowship as early as 1562, and were incorporated as a chartered company in 1629. Though retarded by the civil wars, the manufacture steadily advanced; and so flourishing had it become, that, in 1666, an act of parliament states, that no fewer than forty thousand persons were engaged in the trade. It did not quite escape the curse of protection which came so rapidly into fashion under the reign of the Stuarts, and which, like the hug of the bear, however affectionately intended, is fatal to all that it embraces. But from various causes the prohibitions on foreign silks were not strictly enforced, and the importation was practically free.

The Revocation of the Edict of Nantes drove several hundred thousand of the most industrious of the French into exile; fifty thousand at least settled in England, and at a later period several thousands more migrated to Ireland. These exiled Protestants had "suffered persecution without learning mercy;" too many of them became zealous advocates of a system of exclusive laws, precisely similar to those from which they had themselves suffered most severely. In the interval between 1685 and 1692, the importations of foreign silks into England had exceeded half a million annually in value, and it was during this very period that the British manufacture, exposed to free competition, made the most rapid advance. But in 1697, the parliament, influenced by the petitions of the French Huguenots who had settled in Spitalfields, and perhaps also by the popular outcry

against France and Popery, passed an act prohibiting the importation of French and all other European silk-goods, which, in 1701, was extended to the silks of India and China. To complete the system, an act was passed in 1722, granting bounties on the export of silks for the three ensuing years.

The silk-throwsters of Italy were at this time unrivalled in Europe, on account of the superior machinery they employed, and on them the English weavers chiefly depended for a supply of organzine. In 1715, Mr. Thomas Lombe, whose brother John had visited Italy to become acquainted with the processes and machinery of the silk-throwsters, obtained a patent for the exclusive property in the famous silk-mill which he began to erect in Derby, from the models clandestinely obtained in Italy. To procure these models, John Lombe, disguised as an humble operative, had gone to work in one of the Italian mills, and, in consequence of his apparent destitution, had obtained permission from the proprietors to sleep in the edifice. He employed his nights in making drawings and working models of the machinery which he contrived to bring in safety to England.

The mill erected at Derby came nearer to the idea of a factory of the present day than any previous establishment of the kind. The machine, according to the statement in which Sir Thomas Lombe set forth his claims to the national gratitude, had 97,746 wheels, movements, and individual parts, working day and night; all of these received their motion from one large water-wheel, and were governed by one regulator; and it employed three hundred persons to attend and supply it with work. During the fourteen years which the patent endured, the Lombes did not derive the profit expected from their enterprise—their failure was in some measure caused by the prohibition which the king of Sardinia laid on the export of raw silk,—they petitioned parliament for a renewal of their patent, which was refused, but fourteen thousand pounds were voted to them as a compensation.

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Throwing-mills were now erected in various parts of England; and to encourage capitalists to invest money in this new branch of industry, heavy duties almost, if not altogether, amounting to prohibition, were imposed on the importation of organzine silk. The silk-weavers of Spitalfields, who were thus compelled to buy a worse material of their manufacture at a higher price, could not venture to complain, for they had led the way in asking for prohibition of foreign imports; and the silk-throwsters who, misled by the specious promise of protection, had invested their capital in mills, took little care to provide perfect machinery, and, having once made their outlay, set their faces decidedly against all improvement.

The natural consequences of such a system followed; British silks were the worst and dearest on the face of the earth; French fabrics were smuggled into the country at a rate of half a million annually; and every change of fashion was followed by a series of bankruptcies, because the surplus of silks unconsumed at home could not be disposed of profitably abroad. From 1719 to 1826, the history of the silk-trade offers nothing but complaints of the manufacturers against the import of foreign silks, countless acts of parliament to exclude them, and combinations and outrages on the part of the workmen. It was not to be expected that the operatives should be wiser than their masters; it was not one whit more absurd for the workmen to expect the rate of wages to be kept up irrespective of the profits on the article manufactured, than for the masters to expect the rate of profits to be kept up irrespective of the competitive value of the articles sold. It was utterly useless for legislators to pass laws securing to domestic manufactures, which were both bad and dear, the monopoly of the home-market; the legislators themselves following the natural law of commerce, to buy the best things at the cheapest rate, were notoriously purchasers of contraband goods;

CHAPTER VI.

SPECIAL HISTORY OF THE COTTON MANUFACTURE.

THE history of the cotton manufacture in England is without a parallel in the annals of any age or country. In the beginning of the reign of George III., it gave employment to forty thousand persons, and the value of the goods produced was 600,000*l.*; it now employs not less than fifteen hundred thousand persons, and the value of the goods produced exceeds thirty-one millions. It is difficult to form a conception of the extent of such a manufacture; but the following calculations may help our readers to an intelligible idea of its vastness. The cotton yarn annually spun in England would, in a single thread, girdle the globe 203,775 times; it would reach fifty-one times from the earth to the sun; and it would encircle the earth's orbit eight times and a half. The wrought fabrics of cotton exported in one year would girdle the equatorial circumference of the globe eleven times. The cotton manufacture furnishes one half of British exports, employs one-eleventh of our population, and supplies almost every nation in the world with some part of its clothing. The receipts of the merchants and manufacturers from this single branch of industry, equal two-thirds of the public revenue of the kingdom.

The folly of the opposition to machinery was never so forcibly displayed as in the history of the cotton trade: at this moment, when machines have been invented which enable one man to produce as much yarn as three hundred men could have produced at the accession of George III.—which enable one man and one boy to

print as many goods as a hundred men and a hundred boys could have produced then—when steam-engines perform the work of 33,000 horses, and water-mills of 11,000 horses—so far is manual labour from being superseded, that the number of operatives has increased from forty thousand to one million and a half. Nor has this increase been accompanied by diminution of comfort to the families of the operatives;—the amount paid in wages among the whole of the old operatives (40,000 in number) was but 220,000*l.*,—that is, little more than 2*s.* a week each. Let this state of things be compared with the following estimate of the annual expenditure for cotton manufacture, which was made in the year 1838.

		VALUE.
Consumption of Cotton in . .	1838	£19,604,166
Wages paid—		
Operatives in spinning factories	„	8,659,593
Power-loom weavers . .	„	2,946,000
In bobbinet and hosiery trade .	„	1,650,000
Printers	„	9,360,000
Hand-loom weavers, 280,000, 12*s.* gross	„	8,596,000
Replacing machinery, 8 years taken at the rate of increased capital	4,312,500	
Interest on increased capital, £62,000,000 . . .	3,100,000	
Add for all other charges, oil, gas, flour, clerks, counting-houses, &c. &c. say . .	4,000,000	
9000 capitalists or masters, at wages, chief workmen, say 75*l.* per annum, yearly .	675,000	
		12,087,500
Yearly Expenditure		£62,903,259

There is too much uncertainty in the data which we possess to hazard a conjecture respecting the number of

operatives between whom these eight millions and a half of wages were divided; but in 1835, we calculated from documents no longer in our possession, that the number of operatives had been increased thirty-seven fold since the commencement of the reign of George III., and the rate of wages paid to each individual workman more than quadrupled. The latest information we have obtained respecting wages is contained in the last report made to government by Leonard Horner, Esq., Superintending Inspector of Factories. The information was given in January 1842, by one of the proprietors of a mill in Manchester in which four hundred and fifty operatives are employed.

WEEKLY EARNINGS OF THE EMPLOYED IN A COTTON MILL.

In the preparation department:—

In the blowing or skutching-room, they average about 9*s.*; they are chiefly lads from fourteen to twenty years old.

In the card-rooms:—

Card-tenters, lads	8*s.* to 9*s.*
Strippers and grinders, men	12 „ 13
Drawing frame tenters, young women	8 „ 9
Roving frame ditto	10 „ 11
Others, boys and girls	5 „ 7

Throstle frame spinning; water twist:—

Spinners, young women from fourteen to seventeen years of age, earn from 9*s.* to 11*s.*; they are paid by the amount of work done. The doffers, who are boys from fourteen to seventeen years of age, get from 5*s.* to 7*s.* 6*d.* fixed wages.

Cop reelers, young women, about	8*s.*
Bobbin reelers „ „	10*s.*

The weekly earnings of the above class of hands were about the same in 1838 as now, *but the reduction in the number of hands for the same amount of work done is about twenty per cent.*, effected by various improvements

in the machinery, and more economical arrangement of the work.

The mule spinners are the highest paid class of hands in the mill. In 1838, a mule spinner would spin, upon a large pair of mules (say from 1,200 to 1,300 spindles) 26,000 hanks, for which he was paid 2*s.* 10*d.* per thousand, but out of which he had to pay for his piercers and scavengers 27*s.*, and for gas-light in winter, 2*s.* 6*d.*, thus:—

26,000, at 2*s.* 10*d.* per thousand	£3	13	8
Deduct piercers, &c., and gas .	1	9	6
His weekly earnings	£2	4	2

We now pay 1*s.* 8*d.* per 1,000, but for better work, of which he can produce more from the same machine. He also pays less for his piercers, &c., and does not pay anything for gas, thus:—

28,000, at 1*s.* 8*d.* per thousand .	£2	6	8
Deduct piercers, &c. . . .	1	1	6
His present weekly earnings	£1	5	2

To these estimates we may add the following results of our own personal investigations:—In one large mill in Manchester, employing 959 persons, and spinning very fine numbers only, the average weekly earnings of each person, in December 1841, was 11*s.* 3*d.* In a mill in the parish of Bury, engaged in spinning and power-loom weaving, and employing 357 persons, the average weekly earnings of each person, in December 1841, was 9*s.* 6*d.* And yet with these facts before their eyes, there are some grave persons who pass for wise, and who solemnly lament the increase of machinery as a national calamity, declaring in the teeth of the most incontrovertible facts and figures, that the use of machinery diminishes the amount of employment, and lowers the rate of wages.

Before proceeding to give any account of the use and

progress of the cotton manufacture in England, it will be convenient briefly to touch on the natural history of the raw material, and to collect the earliest notices we can find of its use in the manufacture of clothing.

The cotton-tree (*Gossypium Herbaceum*) is an herbaceous plant, a native of the East Indies, growing to about three feet high. The whole plant is downy, and, while young, sweet-scented. The blossom is of a pale yellow, with five red spots at the bottom; and its seeds, which are ripened in September, are immersed in fine white cotton. The cotton which is produced in China, and of which the cloth called nankeen is made, is said to be tinged with red in its vegetable state, which is supposed to be the cause of its washing of a better colour than any cloth that we can manufacture to imitate it. Few plants are more useful than this: it furnishes clothing to the four quarters of the world; and the seeds are an article of food to the inhabitants where it is cultivated,

There are six species of this genus, of which the Barbadoes cotton is the most cultivated in the West Indies, and forms a considerable branch of their exports. It is set in rows, about five feet apart, grows from four to six feet high, and produces two crops annually; the first in eight months from sowing the seed, and the second four months afterwards. Each plant, at the two gatherings, is reckoned to produce about one pound weight of cotton; and an acre of land to produce 270 pounds' weight on an average.

The certainty of gathering a good crop, however, is very precarious; since it may be almost literally said of this plant, that in the morning it is green and flourishing, and in the evening, withered and decayed. For when the worms begin to prey upon a whole plantation, though they are, at first, scarcely perceptible to the naked eye; yet in three days they will grow to such a size, and prove so destructive, that the most verdant field, thickly and beautifully clothed with leaves and

flowers, is reduced to as naked and desolate a condition as trees are in the month of December in England.

When these worms, which, in their caterpillar state, effect all this mischief, have attained to their full growth, they spin and inwrap themselves, as in a bag, or web, like silk-worms, in the few remaining leaves, or any other covering; and, after remaining a few days in this, their chrysalis state, they turn into dark-coloured moths, and fly away. Cotton is an important object of cultivation, in the southern parts of the United States, and to some extent also in Europe.

Cotton is distinguished in commerce by its colour, and the length, strength, and fineness of its fibre. White is usually considered as characteristic of secondary quality; yellow, or a yellowish tinge, when not the effect of accidental wetting or inclement seasons, is considered as indicating greater fineness.

There are many varieties of raw cotton in the market; their names being principally derived from the places whence they are brought. They are usually classed under the denominations of *long* and *short-stapled*. The best of the first is the *Sea-Island* Cotton, or that brought from the shores of Georgia; but its qualities differ so much, that the price of the finest specimens is often four times as great as that of the inferior. The superior samples of Brazil Cotton are reckoned among the *long-stapled*. The *Upland* or *bowed* Georgia Cotton forms the largest and best portion of the *short-stapled* class. All the cottons of India are short-stapled. The inferiority of Bengal and Surat cotton is sometimes ascribed to the defective mode in which it is prepared; but it is doubted whether it can be grown in India of a better kind. The raw cotton of the Indian islands has hitherto been almost entirely consumed on the spot. A small quantity of very superior cotton has been imported from New South Wales.

The fibres of cotton are shewn, by the microscope, to be somewhat flat, and two-edged or triangular, and to

be not straight but contorted;—a construction which causes the fibres to adhere to each other, and which gives warmth to cotton clothing. The fibres of flax, on the other hand, are straight tubes, with a smooth surface.

Cotton is produced both from annual plants and from trees, of which there are many varieties; and, under proper cultivation, it is raised in such abundance as to be the cheapest of all the materials of clothing.

The cotton plant, in all its varieties, requires a dry and sandy soil. This is the uniform testimony of travellers and naturalists. It flourishes on the rocky hills of Hindoostan, Africa, and the West Indies, and will grow where the soil is too poor to produce any other valuable crop. A mixture of siliceous and argillaceous earth is most desirable with a preponderance of the former. A marshy soil is wholly unfit for the plant, and so little congeniality has it for moisture, that a wet season is destructive to the crops. Of the several diseases to which cotton is subject, and which make the crop a precarious one, the most fatal is the blight produced by wetness at the roots.

The celebrated Sea-Island cotton is much longer in the fibre than any other description. It is also strong and even, of a silky texture, and has a yellowish tinge. Its seed is black, whereas most of the other American cotton is produced from green seed. It is of the annual herbaceous kind. This valuable plant was first sent in the winter of 1786, from the Bahama islands, (where it had been introduced from Anguilla, in the West Indies,) to Georgia, by some of the American royalist refugees, who had settled in the Bahamas at the close of the revolutionary war. The soil and situation of the low sandy islands, which lie along the coast from Charleston to Savannah, were found extremely congenial to the plant, and from them the cotton which it produces derives its name. The great demand for cotton wool in England, (owing to the rapid extension of the manu-

facture,) and the high price fetched by this particular description, induced the Americans to cultivate it with diligence. The quantity raised, however, is limited by the peculiar combination of circumstances requisite for its production, and only a very small proportion of the cotton grown in the United States is of this kind.

Considerable care and attention are necessary in the operation of gathering the ripe cotton. The pods in which it is contained do not all ripen together; consequently, the women and young people who are employed to collect the cotton when the pods open have to go several times through the plantation, as the cotton-wool will be greatly deteriorated if allowed to remain on the trees for any length of time after the pods have opened. The cotton and seeds are plucked, leaving the husk behind. Fine weather is chosen, as any degree of wet on the cotton would make it afterwards become mouldy, and would cause the oil of the seeds to spread upon the wool. That it may be more completely dried, it is exposed to the heat of the sun, on a platform of tiles or wood, for several days after it is gathered; by this means not only the wool but the seeds become dry, in which state they are more easily separated from the wool. The cotton is separated from the seeds in India by means of a small rude hand-mill, or gin, which is usually turned by women. The mill consists of two rollers of teak wood, fluted longitudinally with five or six grooves, and revolving nearly in contact. The upper roller is turned by a handle, and the lower is carried along with it by a perpetual screw at the axis. The cotton is put in at one side, and drawn through by the revolving rollers; but the seeds, being too large to pass through the opening, are torn off, and fall down on the opposite side from the cotton.

The next operation is that of bowing the cotton, to clear it from dirt and knots. A large bow, mad
by a complication of strings, is used; this bei
contact with a heap of cotton, the workman

string with a heavy wooden mallet, and its vibrations open the knots of the cotton, shake from it the dust and dirt, and raise it to a downy fleece. The hand-mill and the bow have been used immemorially throughout all the countries of Asia, and have their appropriate names in the Arabic and other languages: they were formerly used in America, whence the term, still applied in commerce, "*bowed Georgia cotton.*"

This cleaning-mill works very slowly and only turns out from forty to sixty pounds of clean cotton in a day. The Americans use a mill constructed on the same principle of rollers, but on a much larger scale, for cleaning their long-stapled or Sea-island cotton. Hall's travels in America describe a mill of this kind, capable of cleaning eight or nine hundred pounds of cotton in a day:

"It consists of two wooden rollers of about an inch in diameter; these are placed horizontally, parallel, and touching each other. Over them is fixed a sort of comb, having iron teeth two inches long and seven-eighths of an inch apart. This comb is of the same length as the rollers, and so placed that its teeth come nearly in contact with them. When the machine is set in motion, the rollers are made to revolve with great rapidity, so that the cotton being laid upon them, it is by their motion drawn in between the two, whilst no space is left for the seeds to pass with it. To detach these from the fibres of cotton in which they are enveloped, the same machinery which impels the rollers gives to the toothed instrument above a quick, wagging motion to and fro, by means of which the pods of cotton, as they are cast upon the rollers, are torn open, just as they are beginning to be drawn in; the seeds now released from the coating which had encircled them, fly off like sparks to the right and left, while the cotton itself passes between the cylinders. The sharp iron teeth of the comb, moving with great velocity, sometimes break the seeds; then the minute pieces are instantly hurried on, and pass between the rollers with the cotton. These stray particles are afterwards sepa-

rated by hand, a process which is called *moting*. Entirely to cleanse the cotton from any remaining fragment of seed, it is subjected to another process. This consists in whisking it about in a light wheel, through which a current of air is made to pass. As it is tossed out of this winnowing machine, it is gathered up, and conveyed to the packing house, where by means of screws it is forced into bags, each when filled weighing about three hundred pounds. These are then sewed up, and sent to the place of shipment, where they are again pressed, and reduced to half their original size."

This however is not the instrument generally used in cleaning American cotton; the process would be too tedious and expensive for the greater part of the produce grown in the United States. Most species of American cotton are cleaned by the saw-gin, a machine invented by Mr. Eli Whitney, a native of the state of Massachusetts, by which three hundred weight of cotton may be cleaned in a day. We are indebted to Mr. Baines for the following description of this instrument:

"The cotton is put into a receiver, or hopper, of considerable length compared with its width, one side of which is formed by a grating of strong parallel wires, about an eighth of an inch apart. Close to the hopper is a wooden roller, having upon its surface a series of circular saws, an inch and a half apart, which pass within the grating of the hopper to a certain depth. When the roller is turned, the teeth of the saws lay hold of the locks of cotton, and drag them through the wires, whilst the seeds are prevented by their size from passing through, and fall to the bottom of the receiver, where they are carried off by a spout. The cotton is afterwards swept from the saws by a revolving cylindrical brush. When first invented, the wooden cylinder was covered with teeth of wire, like cards, but the saw was found to answer the purpose better. The saw-gin injures in some degree the fibre of the cotton; but it affords so cheap a way of cleansing it, that all the North Amer-

ican cotton, except the Sea Island, undergoes this operation."

India appears to have been the most ancient seat of the cotton-manufacture, whence it spread into Persia and Egypt. In America, where the natives were found by Columbus clothed in cotton, the manufacture was probably an independent invention. It was long believed by the learned that the ancient Egyptians were acquainted with the manufacture of cotton, and that the "white works," mentioned by the prophet Isaiah, were composed of this material; but not a single particle of cotton has been found in any of the countless specimens of mummy-cloth which have been imported into Europe, while fabrics of flax have been found so very fine, and so very like Indian muslin, that we are led to infer that the Egyptians would not have wasted flax, and the enormous labour necessary to bring it to this degree of perfection, if they had had cotton. As no specimens of Babylonian textures exist, we cannot pronounce decisively on the nature of the materials they employed; but as Herodotus, in the fifth century before Christ, distinctly asserts that the Indians wore cotton, it is scarcely possible that the Babylonians, who had an active commercial intercourse with India, could have been ignorant of this material. "The father of history" thus expresses himself: "They possess likewise a kind of plant, which, instead of fruit, produces wool of a finer and better quality than that of sheep; and of this material the Indians manufacture their clothing." Nearchus, the admiral to whom Alexander entrusted the survey of the navigation of the Indus, mentions both the plain cottons and the figured chintzes of the Indians, and the geographer Strabo, who was contemporary with the Christian era, records, that, in his day, cotton-plants were grown, and cotton-cloths manufactured, in Susiana, a province at the head of the Persian gulf.

Pliny, who lived rather more than half a century after Strabo, is the first writer who mentions the growth of

the cotton-plant in Egypt; "The upper part of Egypt," he says, "verging towards Arabia, produces a shrub which some persons call *gossypium* but a greater number *Xylon*, and from this the textile fabrics called *Xylina* are manufactured. It is small and bears a fruit somewhat like a filbert; a downy wool found in the interior is spun into thread; there are no fabrics to be preferred to these for whiteness or softness; the garments made of this material are far the most acceptable to the Egyptian priests." The same naturalist mentions the "wool-bearing trees" of the island of Tylus in the Persian gulf, and says, that they bear a fruit like a gourd, and of the size of a quince *(cotonei mali)*.

This passage has led to as strange an exhibition of etymological perversity as any with which we are acquainted. It has been strenuously maintained that the name "cotton," is derived from *cotoneum* the well-known Latin term for the quince, and this verbal coincidence, which is not one whit more significant than that between "Jupiter" and the "Jew Peter," has been adopted as a legitimate etymology by Skinner and Dr Johnson. The objections to this origin of the word is that the tree-cotton is very rarely used in manufacture; that the quince has no resemblance to it in leaf, and but a slight one in fruit; that, though one species of quince has a downy leaf, the down has not the most distant similarity to cotton-wool; and finally, that the knowledge of cotton was not introduced into Europe by the Latins but by the Arabs. Having rejected the ordinary etymology of the word, we are of course bound to assign what we believe to be its real origin.

The Semitic root כתן *katan* "to adhere or stick closely," is found in one form or another in all the languages of western Asia, and the verbal noun formed from it signifies "a close-fitting garment in Hebrew, Chaldee,*

* With singular infelicity Mr. Baines was directed by some orientalist to the Chaldee קטנית *Quitnith* (not as he gives it *Kitnith*) "a pod

Syriac, and Arabic. For instance, we read that Israel gave Joseph "a coat (כתנת *ketoneth*) of many colours." (Gen. xxxvii. 3.) The Greeks derived both the name and the dress from Asia through the Ionian colonies; they named the tunic χιτων and the Arabs call it *kotôn* and *gottôn* at the present day. It was clearly from the Saracens that the Spaniards obtained the word *Godon*, or with the Arabic article prefixed, Al-godon, which the Italians softened into *cotone*.

It is singular that the English language possessed the verb "to cotton," in its original sense of "adhering closely," and the noun "cotton," as a name for a close-fitting garment, before the vegetable substance of that name was known in England or generally in Europe. Thus one of our oldest translators of Horace,

> So feyneth he, things true and false,
> So always mingleth he,
> That first with midst, and midst with last,
> Maye cotten and agree.
> *Diant. Horace's Art of Poetry.*

Thus also Harrington,

> He meanes, whatever horseman next he spied
> To take his hose of friend or else a foe,
> At this is Discord pleased and said to Pride,
> That she was glad their business *cotton'd* so.
> *Orlando Furioso*, xvii.

To these may be added the authority of Fuller:

"William (Cotton of another family) was made bishop of Exeter; the queen merely saying,—alluding to the plenty of clothing in these parts—that she had well cottoned the west.

Worthies, Hampshire.

We have next to shew that the noun "cottons," was used for an article of dress prior to the introduction of the vegetable material which now bears the name. Leland, the celebrated antiquary, who visited Manches-

or seed vessel." Had he understood the language he would have seen that כתן *kitton* "a tunic" was a word more to the purpose.

ter in the year 1358, thus describes the town in his Itinerary: "Manchester, on the south side of the river Irwell, standeth in Salfordshiret (i. e. the Hundred of Salford) and is the fairest, best builded quickhest and most populous towne of ol the country." Of Bolton, he thus speaks: "Bolton-upon-Moore market standeth most by *cottons*. divers villages in the moores about Bolton do make *cottons*." The nature of these "cottons," is explained in one of the most judicious statutes passed in the reign of Henry VIII., namely, that by which the right of sanctuary was removed from Manchester, on the ground that it tended to the injury of the manufacturing population; some, however, have maintained that this favour was granted in consequence of the adhesion of that town to the cause of the house of Lancaster; but this motive, however powerful with the Seventh, could have had little influence with the Eighth Henry; it is but justice to acknowledge, that neglect of commerce and manufactures cannot be reckoned among the many errors of his reign.

"Whereas, the saide towne of Manchester is and hath of long tyme been a towne well inhabited, and the kinges subiectes inhabitauntes of the same towne are well set a worke in makinge of clothes, as well of lynnen as of woollen, whereby the inhabitauntes of the saide towne haue obteyned gotten and come vnto riches and welthy lyuings, and haue kepte and set manye artificers and poore folkes to worke within the said towne, and by reason of the great occupienge good order strayte and true dealing of the inhabitantes of the saide towne, many strangers, as well of Ireland as of other places within this realme, haue resorted to the saide towne with lynnen yarne, woolles, and other necessary wares for makinge of clothes, to be solde there, and haue vsed to credit & truste the poore inhabitantes of the same towne, which were not able and had not redy money to paye in hande for the saide yarnes wolles and wares vnto such time the saide credites with their industry

labour and peynes myght make clothes of the said wolles yarns and other necessary wares, and solde the same, to contente and paye their creditours, wherein hath consisted much of the common welth of the said towne, and many poore folkes had lyuynge, and children and seruants there vertuously brought up in honest and true labour, out of all ydlenes. And for as muche as of necessitie the said lynnen yarne must lye without as well in the night as in the day cōtinually for the space of one halfe yere to be whited, before it can be made clothe, and the wollen clothes there made must hange vppon the taynter, to be dryed before it can be dressed up, and for the saulfegarde therof it is and shalbe expedie't and necessary, that substanciall honest iuste true and credible persons be and shuld dwell in the sayd towne, and no maner of lyght persone or persons there to be inhabytauntes. And where also many straungers inhabytinge in other towneshyps and places, haue vsed customably to resorte to the sayd towne of Manchester with a great number of *cottons*, to be vttered & solde to the inhabitantes of the same towne, to the great profit of all the inhabitantes of the same and therby many poore people haue ben well set a worke, as wel with dressyng & frisyng of the sayd *cottons*, as with puttyng to sale the same," &c.—33 Henry VIII., c. 15.

The application of the term "frising" to these "cottons," and that of "milling" in a subsequent statute of Elizabeth, shows that they must have been woollen fabrics, to which alone these processes are applicable. Camden also, who visited Manchester in 1590, expressly declares, that these "cottons" were woollens. "This town," he says, "excels the towns immediately around it in handsomeness, populousness, *woollen manufacture*, market-place, church and college; but did much more excel them in the last age, as well by the glory of its *woollen* cloths, (*laneorum pannorum honore,*) which they call *Manchester cottons*, as by the privilege of sanctuary, which the authority of parliament, under

Henry VIII., transferred to Chester." In fact, certain coarse kinds of woollens, retain the name of Kendal and Welsh cottons to the present day.

Cotton-stuffs, properly so called, are first mentioned as an article of commerce in Arrian's Periplus of the Erythrean Sea. He informs us, that they were imported from India to Aduli, a port on the Red Sea; and he specifies as the principal marts of Hindoostan where those goods were obtained, Barygaza, *Baroche*, and Masalia, *Masulipatam*, which was then, as it has ever since been, famous for the manufacture of cotton-piece goods. He adds, that "the transparent Gangetic Lindones" were the most highly valued; and this superiority of the Bengal muslins continues to the present time. We may remark, that the Periplus affords an extraordinary proof of the stationary condition of the arts in India, for the description which Forbes gives of the manufactures of Baroche is nearly identical with that furnished by Arrian sixteen centuries ago. "The cotton-trade at Baroche," he says, "is very considerable, and the manufacture of this valuable plant, from the finest muslin to the coarsest sail-cloth, employs thousands of men, women, and children, in the metropolis and the adjacent villages. The cotton clearers and spinners generally reside in the suburbs, or poorahs, of Baroche, which are very extensive. The weavers' houses are mostly near the shade of tamarind and mango trees, under which, at sun-rise, they fix their looms, and weave a variety of cotton cloth, with very fine baftas and muslins. Surat is more famous for its coloured chintzes and piece goods. The Baroche muslins are inferior to those of Bengal and Madras, nor do the painted chintzes of Guzerat equal those of the Coromandel coast." —Forbes's Oriental Memoirs, vol. ii. p. 222.

We can find no trace of cotton goods imported into Europe before the Fall of the Western Empire; but they began to be introduced into Constantinople about the sixth century, for they are mentioned in the tariff of

import duties issued by the emperor Justinian. In Arabia, however, cottons and muslins had come into common use about the time of Mohammed, for they are frequently mentioned in the history of the early khaliphs. The first "muslins"—so called from their being woven at El Mosél in Mesopotamia—like the English "cambrics," were not composed of cotton, at least, not exclusively, for the muslins mentioned by Marco Polo are expressly stated to have been woven "of gold and silk." The conquests of the Saracens and their successors, the Turks, extended the use of cottons over a great part of Europe, Asia, and Africa. In America there is undoubted evidence that the spinning and weaving of cotton were extensively practised, long previous to the discovery of that continent by Columbus.

The cotton manufacture and the cultivation of the cotton-plant were introduced into Spain by the Saracens, where both flourished for several centuries; the plant still grows wild in the ancient kingdom of Valencia, where its wasted fruitfulness is a sad type of those evil days of Spanish degeneracy. The Christian inhabitants of Spain, notwithstanding their repugnance to adopt Moorish customs, engaged extensively in this pursuit. Cotton manufactures were one of the most flourishing branches of industry in the celebrated commercial city of Barcelona, so early as the thirteenth century. The principal goods produced were sail-cloth and fustians—the latter being a strong fabric used to line garments, and which derived its name from the Spanish word *fuste*, signifying "substance." Thence the manufacture passed into Italy, France, and Flanders; while, on the other side, it was introduced through Turkey into Greece, Germany, and the states of Venice. England, which has outstripped all the others in the race, was one of the last countries to receive it; fortunately, the introduction and early growth of this branch of industry escaped the notice, and consequently the intermeddling of the legislature; it was thus saved

from the blight of protection and prohibitory duties; it was allowed to grow in the invigorating atmosphere of freedom, and it has thus afforded the most splendid example which the history of the world can exhibit, that the best thing the government of a country can do for industry is, "to let it have its own way."

CHAPTER VII.

EARLY HISTORY OF THE COTTON MANUFACTURE IN ENGLAND.

The period when the cotton-manufacture was first introduced into England is unknown. Mr. Baines, however, quotes from the books of Bolton Abbey, in Yorkshire, a record of the year 1298, which shows that cotton-wool was imported at that period for the purpose of making candle-wicks. It is also mentioned as an article of import in the following extract from the curious old poem "The processe of the libel of English police," published in 1480.

"The Genuois comen in sundry wies
Into this land by diuers merchandises
In great Caracks, arrayed withouten lacke
With cloth of gold, silke, and pepper blacke
They bring with them, and of croodt great plentee,
Woll Oyle, Woad ashen, by vessel in the see,
Cotton, Rochalum, and good gold of Genne;
And then be charged with woole again I wenne,
And wollen cloth of ours of colours all."

On the capture and ruin of Antwerp by the duke of Parma, in 1585, great numbers of Flemish manufacturers from that city and from other parts of the Netherlands emigrated to England, and some of them settled in Manchester, where the preposterous jealousy of foreign manufacturers was not then so rife as in other parts

of England. In all probability the cotton manufacture was introduced by those industrious Flemings; and the warden and fellows of the Collegiate church of Manchester, had the good sense to encourage the settlement of the foreigners, by allowing them to cut firing from their extensive woods, as well as to take the timber necessary for the construction of their looms, on paying the small sum of four pence each, annually.

The manufacture grew up in unnoticed obscurity; but it had acquired considerable strength in 1641, when it was noticed by Lewis Roberts, in his valuable little work, entitled "The Treasure of Traffic."

"The town of Manchester, in Lancashire, (says he,) must be also herein remembered, and worthily for their encouragement commended, who buy the yarne of the Irish in great quantity, and, weaving it, returne the same again into Ireland to sell: Neither doth their industry rest here, for they buy *cotton wool* in London, that comes first from Cyprus and Smyrna, and at home worke the same, and perfect it into *fustians, vermillions, dimities,* and other such stuffes, and then return it to London, where the same is vented and sold, and not seldom sent into forrain parts, who have means, at far easier termes, to provide themselves of the said first materials."

The same author further says—

"The Levant or Turkey Company brings in return thereof (i. e. of English woollens) great quantity of *Cotten* and *Cotten-yarne,* Grogram yarne, and raw silke into England (which shewes the benefit accruing to this kingdom by that Company); for here the said cloth is first shipped out and exported in its full perfection, dyed and dressed, and thereby the prime native commoditie of this kingdom is increased, improved, and vented, and the cotton-yarn and raw silk obtained."

Fuller also bears ample testimony to the growing importance of this new branch of national industry.

Amongst the "Worthies of England," he justly enumerates Humphrey Chetham, the beneficent and enlightened founder of the Bluecoat school and library in Manchester. Of this celebrated manufacturer, who was born in 1580, the following account is given:—

"George, Humphrey, and Ralph, (Chetham,) embarked in the trade for which Manchester had for some time been distinguished, the chief branch of which was the manufacture of cottons. Bolton at that period was no less the market for *fustians*, which were brought thither from all parts of the surrounding country. Of these last especially the Chethams were the principal buyers, and the London market was chiefly supplied by them with those materials of apparel, *then in almost general use throughout the nation.*" Humphrey Chetham, "when high-sheriffe of this county, 1635, discharged the place with great honour; inasmuch that very good gentlemen, of birth and estate, did wear his cloth at the assize, to testifie their unfeigned affection to him; and two of them (John Huntley, and H. Wrigley, esqs.) of the same profession with himself, have since been sheriffs of the county."

Cotton-yarn at this period was rarely used except as weft; the flax yielding a more even and firm thread was almost invariably used for the warp. Large quantities of linen-yarn were imported from Ireland and Scotland; supplies were also obtained from Germany through the port of Hamburgh. The cotton-yarns were for the most part spun in the houses of the peasantry, and gave employment chiefly to the female branches of cottiers' families. Travelling chapmen went with their pack-horses from door to door purchasing the cotton-yarn in the small quantities which in the intervals of their farm-labour they had leisure to prepare. These sources of supply were very uncertain, and during the seventeenth century we frequently meet with complaints of the weavers being thrown idle by the difficulty of procuring an adequate supply of yarn. The linen-

weavers of Scotland and Ireland loudly complained of the yarn being brought out of their hands at a high price to be sent to Manchester and there wrought up with cottons. It was even proposed in the Irish parliament to lay a prohibitory duty on the export of linen-yarns, which the reports of the Linen Board in Dublin declared to have increased "in a most alarming manner;" and it is true that the quantity of linen-yarn imported from Ireland into England, in the year 1750, was no less than 2,489,782 lbs. The legislators of that day performed so many odd freaks that it is a subject of surprise how the Irish parliament escaped the blunder of prohibiting a demand for the industrial produce of the Irish people.

An article in the *Gentleman's Magazine*, for 1739, says,—

"The manufacture of *cotton*, mixed and plain, is arrived at so great perfection within these twenty years, that we not only make enough for our own consumption, but supply our colonies, and many of the nations of Europe. The benefits arising from this branch are such as to enable the manufacturers of Manchester alone to lay out above thirty thousand pounds a year, for many years past, on additional buildings. 'Tis computed, that two thousand new houses have been built in that industrious town within these twenty years."

At this time the roads of Lancashire were of the most primitive kind; those which passed through Manchester itself were single-horse lanes, which could be travelled only by pack-horses, and, up to the middle of the last century, these were almost the only conveyances used for the transport of all kinds of goods. A journey from Liverpool to Manchester, which is now performed in little more than half an hour, was thought an extraordinary feat to be accomplished in a single day, and most persons divided the journey into two, halting for a night at Warrington. Dr. Aikin, who lived just as the new system of trade began, has left a very amusing record

of his reminiscences of the old system in his History of Manchester. The state of society as well as the mode of conducting business which he describes, are the most primitive it is possible to conceive. They were essentially the same as those which had existed among the Anglo-Saxons previous to the Norman invasion; indeed, even now, after the great revolution effected in society by factories and machinery, the pure natives of Lancashire display more of the old Saxon sturdiness and industrial spirit than any other portion of the British population.

"It is probable," says Dr. Aikin, "that few or no capitals of 3000*l.* or 4000*l.*, acquired by trade, existed here before 1690. However, towards the latter end of the last [seventeenth] century and the beginning of the present [eighteenth], the traders had certainly got money beforehand, and began to build modern brick houses, in place of those of wood and plaster. For the first thirty years of the present century, the old-established houses confined their trade to the wholesale dealers in London, Bristol, Norwich, Newcastle, and those who frequented Chester fair. The profits were thus divided between the manufacturer, the wholesale and the retail dealer; and those of the manufacturer were probably (though this is contrary to the received opinion) less per cent. upon the business they did than in the present times. The improvement of their fortunes was chiefly owing to their economy in living, the expense of which was much below the interest of the capital employed. Apprentices at that time were now and then taken from families which could pay a moderate fee. By an indenture dated 1695, the fee paid appears to have been sixty pounds, the young man serving seven years. But all apprentices were obliged to undergo a vast deal of laborious work, such as turning warping mills, carrying goods on their shoulders through the streets, and the like. An eminent manufacturer in that age used to be in his warehouse before

six in the morning, accompanied by his children and apprentices. At seven they all came in to breakfast, which consisted of one large dish of water-porridge, made of oatmeal, water, and a little salt, boiled thick, and poured into a dish. At the side was a pan or basin of milk, and the master and apprentices, each with a wooden spoon in his hand, without loss of time, dipped into the same dish, and thence into the milk pan; and as soon as it was finished they all returned to their work. In George the First's reign many country gentlemen began to send their sons apprentices to the Manchester manufacturers; but though the little country gentry did not then live in the luxurious manner they have done since, the young men found it so different from home, that they could not brook this treatment, and either got away before their time, or, if they stayed till the expiration of their indentures, they then, for the most part, entered into the army or went to sea. The little attention paid to rendering the evenings of apprentices agreeable at home, where they were considered rather as servants than pupils, drove many of them to taverns, where they acquired habits of drinking that frequently proved injurious in after-life."

The following table contains the only accurate returns made of the progress of the cotton manufacture previous to the great improvements in machinery:—

COTTON WOOL IMPORTED.		COTTON GOODS EXPORTED.	
1697....	1,976,359 pounds.	1697....	£5,915 official value.
1701....	1,985,868 „	1701....	23,253 „ „
1710....	715,008 „	1710....	5,698 „ „
1720....	1,972,805 „	1720....	16,200 „ „
1730....	1,545,472 „	1730....	13,524 „ „
1741....	1,645,031 „	1741....	20,709 „ „
1751....	2,976,610 „	1751....	45,986 „ „
1764....	3,870,392 „	1764..	200,354 „ „

It will be interesting to pause for a moment, and compare these quantities with the latest information

respecting the cotton-trade, taken from reports presented to parliament.

COTTON TAKEN INTO CONSUMPTION.

In 1816.....	86,580,051 lbs.	J. Marshall's Tables, p. 112.
„ 1820.....	141,912,267 „	
„ 1825.....	205,934,408 „	
„ 1830.....	255,426,476 „	
„ 1835.....	308,602,401 „	Parliamentary Returns.
„ 1840.....	528,142,743 „	

The total weight of *manufactured goods and yarn exported* in the year 1841 was 258,871,745lbs., the value of which amounted to the enormous sum of *seventeen and one quarter millions pounds sterling.*

The capital fixed and floating in every branch of the cotton-trade was in 1834, 40,973,872*l.*; the produce 53,220,091*l.*: and in 1838 it was estimated at 62,961,082*l.*

Previous to the year 1760, the weavers were generally in advance of the spinners, and we find that about the year 1740, merchants began to give out warp yarns to the operatives, together with raw cotton, to be spun into weft. The operations of carding, roving, spinning, and weaving, were performed in the cottage of the operative, and he brought back the finished cloth to the manufacturer. Great facilities and temptations to fraud were opened by this system; travelling pedlars frequently tempted the wives of the workmen to purloin some of the cotton when spun, and exchange it for some tempting article of luxury or convenience. As the bribe was usually a handsome bowl, or other piece of earthenware, the cotton thus purloined was facetiously designated "bowl-weft."

We have conversed with very old persons who remember when the weavers, or their factors, travelled about from cottage to cottage with their packhorses, to collect yarn from the spinsters, often paying a most exorbitant price for it, which absorbed the profits of weaving. This was

the commencement of the system of infant labour, which was at its worst and greatest height before anybody thought of a factory. Spinning was so profitable, that every child in the cottage was forced to help in the process — picking the cotton, winding the yarn, and arranging the card-ends. When the father was a weaver, and the mother a spinner, which was very commonly the case, the tasks imposed upon the children were most onerous: one of our informants, a man over eighty years of age, declared that he never thought of his infancy without shuddering.

CHAPTER VIII.

ERA OF INVENTION. APPLICATION OF MECHANICAL POWER TO SPINNING AND WEAVING.

In our first chapter we have shown, that the art of weaving was anterior to that of spinning, and that the distaff and spindle were called into existence for the purpose of providing materials for the loom. It is a very curious coincidence, that the process of mechanical invention in England followed precisely the same order, and that, the increasing demands of the weaver. Mr. Guest, in his "History of the Cotton Manufacture," states, that "it was no uncommon thing for a weaver to walk three or four miles in a morning, and call on five or six spinners, before he could collect weft to serve him for the remainder of the day; and when he wished to weave a piece in a shorter time than usual, a new ribbon or a gown was necessary, to quicken the exertions of the spinner."

This difficulty was not a little aggravated by a discovery which greatly facilitated the process of weaving. In the year 1738, Mr. John Kay, a native of Bury,

discovered a mode of throwing the shuttle which enabled the weaver to make nearly double the quantity of cloth in a day which he could produce before. A reference to the first print in Hogarth's series of Industry and Idleness will show the old form of the shuttle and lathe; the industrious apprentice has the shuttle in his hand ready to throw it; while the shuttle of the idle apprentice hangs dangling by the thread at the end of the lathe, supplying a plaything for the cat, while the lad sleeps off the effect of debauchery. It will be seen that the shuttle was thrown by the hand, as it is still in the finest kinds of work, and that the hands were in consequence kept constantly extended to the extremities of the warp. Mr. Kay proposed that the lathe, in the groove of which the shuttle runs, should be lengthened about a foot at each end, and that by means of strings attached to these ends and held by a peg in the weaver's hands, motion should be given to the shuttle by a sudden pluck or jerk of the strings. The shuttle thus impelled was called "the flying shuttle," and the peg was denominated "the picking or throwing peg." Though this invention doubled the productiveness of the loom, and at the same time greatly diminished the fatigue of the artisan, Kay, instead of being rewarded for his invention, was persecuted as a dangerous innovator. He was driven from his native land by some of the earliest dupes to the idiotcy, that the invention of mechanical facilities for work would diminish the demand for labour, and died a heart-broken exile. Mr. Robert Kay, the son of the last-named gentleman, added a new invention—that of the "drop-box," by means of which a weaver could at pleasure use any one of three shuttles, each containing a different-coloured weft. The demand for yarn produced by these inventions could not possibly be supplied by the one-thread wheels, and mechanical ingenuity was stimulated to the utmost to furnish the weavers with the materials necessary for their employment.

In order to form some idea of the value of mechanical processes, it is necessary first to have a knowledge of the work which they are intended to perform. If a person takes a lock of cotton-wool he will perceive that its fibres are bent, doubled and twisted in every direction, and if he then pulls to pieces a cotton thread, he will find that all the component parts, or filaments, are laid perfectly straight and parallel with each other. Fibrous elements of considerable length are easily stretched out by being drawn through combs, or hackles; but those of shorter staple, such as some kinds of wool, the tow separated from flax, and the loose filaments from silk, must be carded, that is, drawn through two cards or wire brushes, from which each fleece is stripped in a loose roll about the size of a tolerably thick cord, but of loose consistency and fleecy texture. The cards perform the operation of drawing the fibres straight very imperfectly, especially in materials of very short staple, for if a tooth of the card happens to catch a fibre in the middle it will bend it double. When spinning was performed by hand, the fingers of those engaged in it acquired such delicacy of touch that the irregular fibres were discovered as the roll of cotton taken from the card was attenuated by manipulation into a thin roving, or thread of cotton, in which the fibres are laid parallel to each other, but not formed into a thread by being twisted together. The great object to which mechanical invention was first directed was, the discovery of means for attenuating the roll of carded cotton into a thin roving, fit to be twisted into thread.

The elongation of metal bars and plates by passing them between cylinders appears to have first suggested the idea, that carded rolls of wool and cotton might be lengthened into rovings by the same means. This application of the principle was first made by Mr. John Wyatt of Birmingham, who took out a patent for the invention, in the name of his partner Mr. Paul, in 1738. The machines constructed by Wyatt, however excellent

in principle, were so imperfect in their details, that they could not be profitably worked. Wyatt had not the capital necessary to carry out his plans, nor the steady application to conduct the varied experiments by which a mechanical principle can alone be brought into complete operation. Moreover, Wyatt was quite unacquainted with the cotton business, and was therefore very likely to follow the analogy of laminating metals too far, without sufficiently allowing for the great difference of materials.

On referring to Wyatt's patent, which was enrolled on the 20th of July 1738, we find that his specification includes all the principles of spinning by means of rollers, so far as the elongation of the roving was concerned; but there are so many deficiencies and imperfections in the detail, that it must be regarded rather as the germ of an invention than as a complete piece of mechanism. We quote from the copy of the patent published by Mr. Baines:

"The said machine, engine, or invention, will spin wooll or cotton into thread, yarn, or worsted, which, before it is placed therein, must be first prepared in manner following, (to wit,) all those sorts of wooll or cotton which it is necessary to card must have each cardfull, batt, or roll joyned together so as to make the mass become a kind of a rope or thread of raw wooll: in that sort of wooll which it is necessary to combe, commonly called jarsey, a strict regard must be had to make the slivers of an equal thickness from end to end: the wooll or cotton being thus prepared, one end of the mass, rope, thread, or sliver, is put betwixt a pair of rowlers, cillinders, or cones, or some such movements, which, being twined round by their motion, draws in the raw mass of wooll or cotton to be spun, in proportion to the velocity given to such rowlers, cillinders, or cones: as the prepared mass passes regularly through or betwixt these rowlers, cillinders, or cones, a succession of other rowlers, cillinders, or cones, moveing proportionably faster than

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give the slightest information to any persons who have sought it for the purpose of publication. We may, however, fairly take the case on the evidence given at the trial for determining the validity of Arkwright's patent in 1785. From this it would appear, notwithstanding Wyatt's ascertained claims, that the application of rollers to spinning was an independent invention on the part of Highs; but it is at least equally clear, that he had no very definite ideas of its practical application and value. It does not appear that he ever perfected a single machine on the new principle; he did not apply to any manufacturer for assistance or capital to give his discovery a fair trial; and his communications to Kay, so far as the clockmaker's account of them is intelligible, are clearly more like tentative guesses and experiments, than the directions which would be given by a man who comprehended his subject. Indeed, had Highs been able to appreciate the subject-matter of the discovery, his means were far more extensive and available than Arkwright's for bringing the invention to completeness.

Highs had some reputation as a mechanist; he was a reed-maker, and therefore known to many cotton-manufacturers: indeed, in 1772 his mechanical ingenuity was rewarded by a present of two hundred guineas from the manufacturers of Manchester, for his invention of a spinning machine which was exhibited at the Exchange. Had such a man been convinced of the practicability of his project, he would easily have found means for bringing it into actual work. A loose notion floating through the mind, followed by two or three imperfect, and confessedly imperfect, attempts for its realization, may give a man a title to ingenuity, but are far from establishing a claim to invention.

Arkwright was a barber at Bolton, where some particulars of his early history are still preserved by tradition: he was, it is said, shy and reserved, mixing little with his neighbours, devoting his leisure time to chemical and mechanical experiments. He discovered some process

for dyeing the hair, which was probably of some value at a time when wigs were generally worn. But he was inattentive to his business, proverbial for his want of punctuality, and downright rude to those who complained of being disappointed. As his business declined, he devoted himself more sedulously to mechanical pursuits; he hoped to be able to discover perpetual motion, a folly which he shared with some of the most eminent mechanists of the day. A similarity of tastes and pursuits brought him acquainted with Kay, and from him he unquestionably received the first hint of the process of spinning by rollers. On referring to Kay's evidence, which is as loose as any that was ever given and received in a court of justice, it is quite manifest that Kay at the time attached no importance to the secret which he communicated; and there appears some reason to believe that Arkwright was not immediately aware of its value, and only became aware of its great worth by subsequent experiment and reflection.

It is much to be regretted that there are no materials for the history of Arkwright's early struggles in bringing his machinery to perfection. We do not even know the means by which he acquired sufficient money to set up his first spinning-machine, as an experimental model, in the parlour of the Free Grammar School at Preston. Not less interesting would be the detail of his efforts to overcome the determined hostility to machinery which was then fiercely rife in the county of Lancashire, a hostility which Arkwright bitterly resented to the last hour of his life; he never forgave the manufacturers of Manchester, and assuredly they never manifested any superabundance of affection for him. In consequence of the neglect or dislike with which his projects were treated by the Lancastrians, he quitted the county, and resolved to establish his spinning-machinery in the town of Nottingham.

Arkwright first applied to Messrs. Wright, the bankers, for some pecuniary aid, which was granted on the con

dition of a share in the profits. The perfecting of the machine, however, required more time and a greater outlay of capital than the bankers had anticipated; they therefore advised the adventurer to obtain other assistance, and introduced him to Mr. Need, the partner of Mr. Jedediah Strutt, who had some time before obtained a patent for a most ingenious improvement of the stocking-frame.

Mr. Strutt was one of the most remarkable and estimable men of his day; originally educated as a farmer, he had directed his attention to mechanical improvements, and had discovered the means of weaving ribbed stockings in the stocking-frame. He saw at a glance the merits of Arkwright's invention, and the defects in the adjustment of the parts which impeded its working. A partnership was proposed and accepted; the capital of Messrs. Need and Strutt relieved Arkwright from pecuniary difficulties; he soon made his machine practicable, and in 1769 he secured his invention by a patent. There is reason to believe that Arkwright was more deeply indebted to the mechanical genius of Mr. Jedediah Strutt than his friends have been willing to acknowledge; but Mr. Strutt was already too rich in unquestioned fame to envy a small share to others.

Arkwright's machine was the origin of the modern Throstle: it was first set in motion by horse-power, but it was subsequently driven by a water-wheel, whence it received the name of the "water-frame," and the yarn produced was for the same reason called "water-twist," a name which this quality of yarn still retains. Some of Arkwright's original water-frames are, it is said, still in use at Cromford in Derbyshire, the first extensive mill erected by him and his partners; but the jealousy with which strangers are excluded from the establishment, renders it difficult to obtain any positive knowledge on the subject.

The specification annexed to Arkwright's patent shews

that his water-frame, in its principles, includes both the modern drawing-frame and throstle. The original purpose of the machine was to convert the rovings into yarn; but it was so obviously applicable to the formation of the rovings themselves, that the drawing-frame can scarcely be considered a separate invention. Arkwright applied his mind to every process used in the preparation of cotton, and introduced improvements into them all. He may indeed be regarded as the founder of the Factory system, for he established such a continuous union between all the processes, and so multiplied the processes themselves, that it was requisite to have the whole conducted in a single building.

Arkwright's claims have been discussed as if the whole question of his merits depended upon the invention of the "water-frame;" but in truth he has a right to be considered as the first person who ever organized a cotton-mill, and had a distinct view of all the processes that were to be carried on within its walls. His comprehensive genius enabled him in one view to see all the changes which the fibres should undergo, from their first appearance as tangled wool, to their coming out from the last frame a smooth and finished thread. It has been narrated by those who worked under him, that, when any imperfection was discovered in his yarn, he could, in a moment, state which of the processes through which it had gone was the cause of the defect; and thus his whole life may be regarded as one of invention, for he was almost continually discovering new mechanical facilities for the better working of the machines. It is unfortunate that some incomprehensible feelings should induce the successors of such a man to consign his labours "to cold obstruction," particularly as evil is suspected where such rigid secrecy is observed.

A very different invention, derived immediately from the old hand-wheel, and more analogous to the ancient system of spinning, as it combined twisting

with the elongation of the fibre, must next engage attention. We have already stated, that the old principle of wool-spinning was to draw out a definite length of roving during the revolution of the spindle to which the end of the roving had been previously attached; and this was effected by the hand-wheel, which the spinner turned with one hand, while she drew out the roving and afterwards wound it on the horizontal spindle with the other. About the year 1764, James Hargreaves, a weaver, near Blackburn, having a wife and seven young children to support from his earnings, felt very acutely the difficulty of obtaining weft, the labours of his family being far from sufficient to procure him an adequate supply. It happened that he observed a one-thread wheel overturned upon the floor, when the wheel and spindle continued to revolve. This led him to consider what would be the effect of placing the spindles perpendicularly instead of horizontally, and he rightly concluded that it would be possible to make several spindles, thus placed in a row, revolve by the turning of a single wheel. In other words, he conceived the possibility of spinning several threads at once. The machine which he invented was called the "Spinning-Jenny," probably because "Jenny" was a cant name for the old hand-wheel which it superseded.

The Spinning-Jenny is in fact a mere multiple of the hand-wheel, and is only applicable to the last stage of the process in the manufacture,—the conversion of the roving into yarn. In its original state it could scarcely be applied to cotton-spinning, for the yarn it produced went through a very imperfect process of attenuation. Its spindles were set in motion by bands passing round their whorls over a cylinder which was made to revolve by a driving band attached to a wheel turned by the spinner. The rovings were given out by means of a moveable carriage, traversing the top of the frame in which the spindles were set. This was therefore the

extension of an old, not the invention of a new principle; and the chief points of novelty were the working of spindles upright, and the regulation of the winding of the yarn on their cops by means of a faller wire. Like the original one-thread wheel, the spinning-jenny was a domestic implement; it was soon introduced into the houses of the Lancashire farmers and yeomen, and was worked for the most part by the mothers of families, assisted by their children. Improved spinning-jennies are still used in places where coarse flannels and blankets are manufactured, because it is not of consequence in these to have a fine and even thread. We found some in the cottages on the hills skirting Rochdale and Todmorden.

Hargreaves for some time kept his invention secret, using the jenny only to obtain weft for his own loom. The vanity of his wife induced her to betray the secret; the neighbouring spinners were alarmed, they feared that such an invention would deprive them of employment; a mob assembled, forced Hargreaves' house, broke his machinery to pieces, and menaced his life. He removed to Nottingham, where he entered into partnership with Mr. John James, and took out a patent for his invention; but having sold some jennies before leaving Lancashire, to obtain clothing for his children, the patent could not be sustained, and he lost all the fruits of his discovery. It has been erroneously asserted, that he died in great distress; but, though he did not acquire a great fortune, his industry and activity enabled him to earn a moderate competence, and bequeath a decent provision to his widow and children.

Attention was very early directed to the improvement of the process of carding, originally the most clumsy, but now one of the most beautiful in the cotton-manufacture.

An explanation of the object to be attained, is necessary for those who have not paid some attention to the subject. In order that any material should be spun, that is, should have its fibres twisted together, it is es-

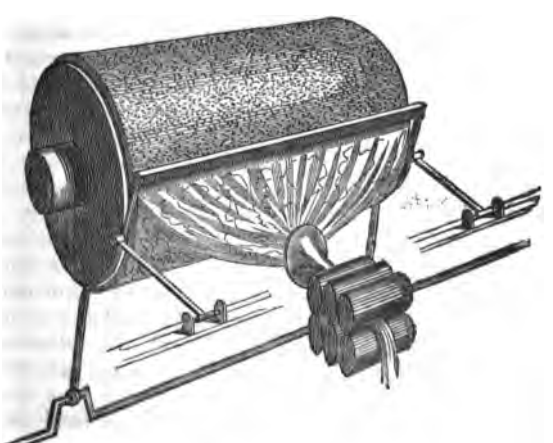
sential that these fibres should be straight and parallel with each other. After having been subjected to the action of the willow, the fibres of the cotton are blown about in every direction, and, if compressed, would be entangled with each other. This, which is the object to be gained for the process of felting, is precisely that which must be carefully avoided for spinning. In order to straighten the fibre, the cotton is made to pass between cards or brushes of wire, one of which is stationary and the other in motion: the wire teeth catch the fibres, and by their continued action pull them into nearly parallel directions.

This process was anciently, and in some rural districts both of England and Ireland is still, effected by hand-cards, which might be described as two brushes with handles, having short wires instead of hairs. The labour was usually performed by women, who placed one of the cards on the knee, holding it firm with the left hand; and then, spreading the cotton or wool in small quantities over the wire, drew the other card repeatedly over it with the right hand until the fibres were deemed sufficiently straight. When thus prepared, the cardings were taken off in a roll by the hand, and laid so as to be united into a continuous roving by the spinning-wheel.

The first great improvement in this process was to fix one of the cards to a table and suspend the other from the ceiling, so that the workman could move it without having to sustain its weight. Such a contrivance allowed "stock-cards," as they were called, to be made of double the size of hand-cards, and consequently to double the quantity of work produced. We have seen stock-cards in some rural districts, where there is still a domestic manufacture of woollens, but they are daily becoming of more rare occurrence. In nearly all manufactures they have been superseded by the cylindrical cards, which Mr. Baines has shewn to be the invention of Mr. Lewis Paul of Birmingham, about the year 1748. About 1760, the process, which seems to have been

either neglected or disused, was revived by Mr. Morris of Wigan, and applied to the carding of cotton. The perfecting of the machine has been claimed for Sir Richard Arkwright, but the originality of his invention has been very fiercely contested. Without entering into the controversy, or dwelling on successive changes and improvements, we shall proceed to describe briefly the machine in its present state.

The carding machine has the appearance of a cylindrical box, into which cotton is given by the roller, round which it was wrapped in the spreading operation. Its wooden covering is a series of narrow panels; and, if one of these be lifted, it will be seen that each of them is a card, and that a cylinder covered with cards occupies the interior of the box, between which and the moveable cards forming the cover of the box the wool is drawn into straight fibres, after which its fleeces are wound spirally round the second cylinder, which is called a *doffer*, so as to remove the carded cotton in a continuous filmy sheet. The cotton is slipped from the doffer by the action of a slip of metal, finely toothed like a comb,



which, being worked against the cylinder by means of a crank, beats or brushes off the cotton in a fine filmy fleece. The cloud-like appearance of the carded cotton, as it is brushed from the doffer or finishing cylinder by the crank and comb, is singularly beautiful; a breath seems to disturb the delicacy of its texture, and to the touch it is all but impalpable. The filmy fleece is gradually contracted as it passes through a funnel, by which it is forced to assume the shape of a roll or sliver. It then passes between two rollers, by which it is compressed into the shape of a riband of considerable tenacity, in which state it coils itself up in a deep tin can.

The process of invention had gone thus far when the art of cotton-spinning was rendered poetical by Darwin's powers of description and embellishment. He introduced into his "Botanic Garden," a poem which, after having been most extravagantly eulogized, has now fallen into unmerited neglect, the following graphic and imaginative account of Arkwright's establishment at Cromford on the Derwent.

——— "Where Derwent guides his dusky floods
Through vaulted mountains and a night of woods,
The nymph *Gossypia* treads the velvet sod,
And warms with rosy smiles the wat'ry god;
His pond'rous oars to slender spindles turns,
And pours o'er massy wheels his foaming urns;
With playful charms her hoary lover wins,
And wields his trident while the Monarch spins.
First, with nice eye, emerging Naiads cull
From leathery pods the vegetable wool;
With wiry teeth *revolving cards* release
The tangled knots, and smooth the ravell'd fleece;
Next moves the *iron hand* with fingers fine,
Combs the wide card, and forms th' eternal line;
Slow with soft lips the *whirling can* acquires
The tender skeins, and wraps in rising spires
With quicken'd pace *successive rollers* move,
And these retain, and those extend, the *rove*
Then fly the spokes, the rapid axles glow,
While slowly circumvolves the labouring wheel below."

The spinning-jenny was superior to Arkwright's

"throstle" or "water frame" in twisting the yarn compactly, but it was obviously deficient in having no contrivance for elongating the roving. On the other hand, "the water-frame," though it spun a warp-thread, could not well be used for very fine yarns, or, to speak technically, for high numbers, because thread or rovings of great tenuity have not sufficient strength to bear the pull of the rollers while being wound on the bobbins. This defect was remedied by a compound of the two machines, called from this admixture "the mule," which was invented by Mr. Samuel Crompton, a weaver of respectable character and circumstances, who resided at "Hall-in-the-Wood," an ancient farm-house, in the township of Turton, near Bolton.

The "Hall-in-the-Wood" is a spot as romantic as its name denotes; it stands nearly at the extremity of a hilly spur, which projects into one of the tributaries of the Irwell, and is a very beautiful specimen of the picturesque cage architecture, which is every day becoming more rare. It was Crompton's hope, that he would be permitted to enjoy his little invention in this spot of tranquil retirement; but the superior qualities of his yarn, for his machine enabled him to spin eighties at a time when no other existing machinery could go so high as forties to the pound, prevented the realization of that hope.

It may be necessary to mention, that yarn is technically designated from the number of hanks, containing 840 yards each, which weigh a pound. In Crompton's time it was considered impossible to spin Eighties, but now, to such perfection has the mule been brought, that Mr. Houldsworth has produced yarn the tenuity of which is equal almost to gossamer: there were 450 hanks in the pound, which at 840 yards to the hank, gives a length of 378,000 yards, or about 215 miles. This is, however, a very unusual degree of fineness; it is very rare that higher numbers than 300 are used in any manufacture.

The distinguishing feature of the mule is, that the

spindles, instead of being stationary, as in both the other machines, are placed on a moveable carriage, which is wheeled out to the distance of fifty-four or fifty-six inches of the roller-beam, in order to stretch and twist the thread, and wheeled in again to wind it on the spindles. In the jenny, the clasp, which held the rovings, was drawn back by the hand from the spindles; in the mule, on the contrary, the spindles recede from the clasp, or from the roller-beam which acts as a clasp. The rollers of the mule draw out the roving much less than those of the water-frame; and they act like the clasp of the jenny, by stopping and holding fast the rove, after a certain quantity has been given out, whilst the spindles continue to recede for a short distance further; so that the draught on the thread is in part made by the receding of the spindles. By this arrangement, comprising the advantages both of the rollers and the spindles, the thread is stretched more gently and equably, and a much finer quality of yarn can therefore be produced.

We have conversed with several persons who were personally acquainted with Crompton, and they all coincided in asserting that when he first made his machines, —then called "Hall-in-the-wood wheels,"—he was unacquainted with the success of Arkwright's process of spinning by rollers. This, indeed, we believe to have been the case, and if correct, it would greatly confirm the view which we have already taken of Arkwright's real merits,—namely, that he adopted, but did not invent, the principle of spinning by rollers; and that his true claim to national respect and gratitude is his early perception of the great results to be derived from the practical application of that principle.

Mr. Kennedy, one of the first authorities in all questions relating both to the theory and application of mechanical science, has given the following account of Crompton's invention in the *Transactions of the Manchester Philosophical Society:*

"Mr. Crompton's first suggestion was to introduce a

single pair of rollers, viz. a top and a bottom, which he expected would elongate the rove by pressure, like the process by which metals are drawn out, and which he observed in the wire-drawing for reeds used in the loom. In this he was disappointed, and afterwards adopted a second pair of rollers, the latter pair revolving at a lower speed than the former; and thus producing a draught of one inch to three or four. These rollers were put in motion by means of a wooden shaft with different-sized pulleys, which communicated with the rollers by a band. This was certainly neither more nor less than a modification of Mr. Arkwright's roller-beam: but he often stated to me, that when he constructed his machine, he knew nothing of Mr. Arkwright's discovery. Indeed, we may infer that he did not, otherwise he would not have gone thus rudely to work; and certainly the small quantity of metals which he employed, proves that he could not have been acquainted with Mr. Arkwright's superior rollers and fixtures in iron, and their connexion by clockwork. Even the rollers were made of wood, and covered with a piece of sheep-skin, having an axis of iron with a little square end, on which the pulleys were fixed. Mr. Crompton's rollers were supported upon wooden cheeks or stands. His tops were constructed much in the same way, with something like a mouse-trap spring to keep the rollers in contact. His first machine contained only about 20 or 30 spindles. He finally put dents of brass-reed wire into his under-rollers, and thus obtained a fluted roller. But the great and important invention of Crompton was his spindle carriage, and the principle of the thread having no strain upon it until it was completed. This was the corner-stone of the merits of his invention."

Crompton's invention was very coolly appropriated by some of the great manufacturers in his neighbourhood, who did not feel themselves bound to give him any adequate remuneration for his valuable discovery. In the year 1812, however, some gentlemen of Manchester

made a strong representation of Crompton's claims to the government, and procured for him a parliamentary grant of £5000. He employed this sum in establishing his sons in the bleaching business; but they, from a concurrence of untoward circumstances, unfortunately failed, and Crompton, with his daughter, was reduced to poverty. His indefatigable friend, Mr. Kennedy, exerted himself to raise a subscription with which a small annuity was purchased for this great benefactor of British industry; but he did not enjoy it more than two years. He died in the beginning of the year 1827, and we believe that no monumental stone marks the place of his interment.

The next great improvement, and the latest of any magnitude, was the construction of self-acting mules, which roll the spindle-carriages in and out without any manual aid from the spinner, and perform the still more delicate operation of guiding the fallen-wire so as to regulate the winding of the yarn on the cops. The first machine of this kind was invented by Mr. William Strutt, of Derby; and nearly at the same time a similar machine was independently invented by Mr. Kelly, of Lanark; but the self-acting mules which have been most successfully employed, are those manufactured by Mr. Roberts, for which a patent was obtained in 1825. Great improvements have also been made in the "throstle" or "water-frame," which is still used in preference to the mule for spinning yarn of low numbers.

The spirit of improvement was next directed to the process of weaving, and in the year 1785, a power-loom, which may be regarded as the parent of the machine now in use, was invented by the Rev. Dr. Edmund Cartwright, brother of the celebrated Major Cartwright, the well-known advocate of radical reform. The circumstances which led to this invention are thus stated by the Rev. gentleman himself, in a letter to the writer of the article on cotton-manufactures, in the Encyclopædia Britannica:

"Happening to be at Matlock, in the summer of 1784, I fell in company with some gentlemen of Manchester, when the conversation turned on Arkwright's spinning-machinery. One of the company observed that, as soon as Arkwright's patent expired, so many mills would be erected, and so much cotton spun, that hands never could be found to weave it. To this observation I replied, that Arkwright must then set his wits to work to invent a weaving-machine or mill.* This brought on a conversation on the subject, in which the Manchester gentlemen unanimously agreed that the thing was impracticable; and in defence of their opinion, they adduced arguments which I certainly was incompetent to answer, or even to comprehend, being totally ignorant of the subject, having never at that time seen a person weave. I controverted, however, the impracticability of the thing by remarking, that there had lately been exhibited in London an automaton figure which played at chess. Now you will not assert, gentlemen, said I, that it is more difficult to construct a machine that shall weave, than one which shall make all the variety of moves which are required in that complicated game?

"Some little time afterwards, a particular circumstance recalling this conversation to my mind, it struck me that, as in plain weaving, according to the conception I then had of the business, there could only be three movements, which were to follow each other in succession, there would be little difficulty in producing and repeating them. Full of these ideas, I immediately employed a carpenter and smith to carry them into effect. As soon as the machine was finished, I got a weaver to put in the warp, which was of such materials as sail-cloth is usually made of. To my great delight, a piece of cloth, such as it was, was the produce. As I had never before turned my thoughts to any thing mechanical, either in

* Dr. Cartwright probably spoke at random, but we have heard on good authority, that Sir Richard Arkwright did make several experiments for the purpose of applying power to weaving.

theory or practice, nor had ever seen a loom at work, or knew any thing of its construction, you will readily suppose that my first loom was a most rude piece of machinery. The warp was placed perpendicularly, the reed fell with the weight of at least half a hundred-weight, and the springs which threw the shuttle were strong enough to have thrown a Congreve rocket. In short, it required the strength of two powerful men to work the machine at a slow rate, and only for a short time. Conceiving, in my great simplicity, that I had accomplished all that was required, I then secured what I thought a most valuable property, by a patent, 4th April, 1785. This being done, I then condescended to see how other people wove; and you will guess my astonishment, when I compared their easy modes of operation with mine. Availing myself, however, of what I then saw, I made a loom, in its general principles, nearly as they are now made. But it was not till the year 1787 that I completed my invention, when I took out my last weaving patent, August 1st, of that year."

Dr. Cartwright entered into business, but failed; his ingenuity was, however, rewarded by a parliamentary grant of £10,000. Notwithstanding many improvements effected by Radcliffe, the inventor of the dressing-frame, Horrocks, and Marsland, the progress of the power-loom was very slow, and in the year 1813 there were probably not more than 2,500 of these machines in the kingdom. Great distress was occasioned at this crisis by our anti-commercial Orders in Council, and the American war which they provoked, and of this some designing persons took advantage to persuade the operatives, that employment had been diminished in consequence of the use of machinery; and the hostility of the hand-loom weavers was in particular exerted and directed against the power-looms. We have taken some pains to inquire into the real nature of the riots that took place, from the survivors of those who were actually engaged in them, and we have no doubt whatever that the ignorant operatives

were instigated to acts of violence by hired agents; but we have just as little doubt, that these agents went far beyond the directions which they received from their employers.

The factories of West-Houghton were destroyed; a profitable branch of industry was driven from that locality to which it has never returned, and West-Houghton became what it still continues to be, the most poverty-stricken district in the whole county of Lancashire. The power-loom, driven from West-Houghton, sought shelter in a secluded nook adjoining to three counties, where there was neither church, magistrate, nor school. Here this branch of industry found a refuge and took root; Stayley-Bridge, which seems to have been chosen by the patrons of the power-loom simply because it was neglected and deemed worthless by everybody else, is one of the most remarkable instances of the rapid accumulation of wealth, population, and buildings, produced by the cotton-manufacture, even in that land of wonders over which this branch of industry has spread. Some years ago it was a miserable hamlet, remarkable only for the picturesque views from the Old Bank, a steep hill which rises boldly above the north bank of the river; and, before the prospect was shut out by building, commanded an extensive view of very rich scenery. The cottagers, in addition to their agricultural pursuits, employed themselves in spinning woollen yarn for the manufacture of stockings; there was only one dyer in the place, and he possessed the solitary piece of workmanship which could be said to make any approach to machinery, which consisted of two wheels turned by mastiffs, similar to the dog-wheels anciently used in kitchens. It is now a flourishing town with municipal institutions of its own, and extends to some distance on the Cheshire side of the river. The persons employed in the mills and factories have come at different times from the agricultural counties and districts; they

are in fact colonists, not connected with Lancashire by birth or relationship, and are therefore very slightly influenced by local attachments.

The village of Mosley, and the hamlet of Hartshead, have shared in the general improvement of the district. It is remarkable that in no place was the introduction of machinery more vehemently opposed than in the localities which it has subsequently most enriched. When Mr. Hall erected the first steam-engine for spinning by power, in 1796, he was obliged to convert his mill into a garrison, and keep the gates locked both by day and night. Time dissipated these alarms, and now some of the finest specimens of machinery are found in Stayley-Bridge and its neighbourhood.

An invention by a French operative produced about the same time a greater revolution in silk-weaving than even the power-loom in the manufacture of cottons. The author of this invention was M. Jacquard, and the following interesting particulars respecting him are taken from Dr. Bowring's Evidence before the House of Commons' Committee on the Silk Trade; they were communicated to Dr. Bowring by Jacquard himself:

"He was originally a manufacturer of straw-hats at Lyons, and it was not until the peace of Amiens that his attention was first attracted to the subject of mechanism. The communication between England and France being then open, an English newspaper fell into his hands. In this he met a paragraph stating, that a premium would be awarded by a society in this country to any person who should weave a net by machinery. The perusal of this extract awakened his latent mechanical powers, and induced him to turn his thoughts to the discovery of the required contrivance. He succeeded, and produced a net woven by machinery of his own invention. It seems, however, that the pleasure of success was the only reward which he coveted, for as soon as accomplished he became indifferent to the work of his ingenuity—threw it aside for some time and

subsequently gave it to a friend as a matter in which he no longer took any interest. The net was by some means at length exhibited to some persons in authority, and by them sent to Paris. After a period had elapsed, in which M. Jacquard declares that he had entirely forgotten his production, he was sent for by the prefect of Lyons, who asked him if he had not directed his attention to the making of nets by machinery. He did not immediately recollect the circumstance to which the prefect alluded; the net was however produced, and this recalled the fact to his mind. The prefect then rather peremptorily desired him to produce the machine by which this result had been effected. M. Jacquard asked three weeks for its completion; at the end of which time he brought his invention to the prefect, and directing him to strike some part of the machine with his foot, a knot was added to the net. The ingenious contrivance was sent to Paris, and an order was thence despatched for the arrest of the inventor.

Under Napoleon's arbitrary government even the desire for the diffusion of improvements was evinced in a most unconciliatory manner; and while inventions in the useful arts were sufficiently prized, no respect was paid to those persons by whom they were originated. Accordingly, M. Jacquard found himself under the keeping of a gens-d'arme, by whom he was to be conducted to Paris in all haste, so that he was not permitted even to go home to provide himself with the requisites for his sudden journey. When arrived in Paris he was required to produce his machine at the Conservatory of Arts, and submit it to the examination of inspectors. After this ordeal he was introduced to Bonaparte and to Carnot, the latter of whom said to him, with a look of incredulity—"Are you the man who pretends to this impossibility—who professes to tie a knot in a stretched string?" In answer to this inquiry the machine was produced and its operation exhibited and explained. Thus strangely was M. Jacquard's first mechanical experiment

brought into notice and patronised. He was afterwards required to examine a loom on which from twenty to thirty thousand francs had been expended, and which was employed in the production of articles for the use of Bonaparte. M. Jacquard offered to effect the same object by a simple machine, instead of the complicated one by which the work was sought to be performed,—and improving on a model of Vaucanson, produced the mechanism which bears his name. A pension of a thousand crowns was granted to him by the government as a reward for his discoveries, and he returned to Lyons, his native town. So violent, however, was the opposition made to the introduction of his loom, and so great was the enmity he excited in consequence of his invention, that three times he with the greatest difficulty escaped with his life. The *Conseil des Prud' hommes*, who are appointed to watch over the interests of the Lyonese trade, broke up his machine in the public *place*; "the iron (to use his own expression) was sold for iron—the wood for wood, and he, its inventor, was delivered over to universal ignominy." The ignorance and prejudice which caused the silk-weavers of Lyons to destroy a means of assistance to their labours, capable of being made a source of great benefit to themselves, was not dispelled till the French began to feel the effects of foreign competition in their silk manufacture. They were then forced to adopt the Jacquard loom, which led to such great improvement in their silk weaving, and this machine is now extensively employed through the whole of the silk manufacturing districts of France as well as of England.

The chief difficulties against which the English manufacturers had to contend were legislative interference, the hostility of the operatives to new machinery, and the senseless jealousy with which the bulk of manufacturers long regarded any sudden prosperity in one of their body. By an act of parliament passed in 1720, de-

signed to protect the silk and woollen manufacturers, the use of any printed or dyed calicoes, or of any printed or dyed goods of which cotton formed a part, was, with some trifling exceptions, absolutely prohibited. This law was intended to protect domestic industry by excluding Indian calicoes; but, besides the loss it entailed on consumers, it was injurious to the home manufacturer, for it sadly limited his choice of the materials of production. When it was found that cotton-yarn, suitable for weft, could be spun in England, the legislature so far relaxed the law in 1736 as to allow the use of mixed goods, "provided that the warp thereof be entirely linen-yarn." This clause of exception was directed against Indian goods, for no one at that time dreamed that cotton-yarn suitable for warps, could ever be spun in England.

Arkwright's "water-frame" produced yarn sufficiently strong for warps, and as the legislative prohibition was professedly designed to protect British industry by excluding the produce of the Indian loom, he reasonably demanded that the clause should not be so interpreted as to exclude goods woven with British-spun warps, although these warps were cotton-twist. To the everlasting disgrace of the manufacturers of Lancashire, they actually petitioned parliament for the continuance of this excluding clause, from no better motive than jealousy of Arkwright, who was the person to whom profit would most immediately accrue from a relaxation. It is not the first time that we find in commercial history merchants and manufacturers petitioning for measures that demonstrably would ensure ruin, and protesting against measures absolutely essential to their mercantile salvation; but anything so senseless, so despicable, and so utterly suicidal, as this opposition to the establishment of the manufacture of entire cotton fabrics in England is not to be found in the annals of human absurdity. How often must these precious petitioners

against free trade have blessed their stars that their darling object was not attained, and that their suicidal prayers were not heard!

Hostility to machinery was not confined to the working classes: many persons in the middle and higher ranks shared in the delusion, that machinery would lessen the demand for labour, and throw multitudes out of employment. They forgot that no combination of brass and iron, of wheels and screws, can possibly *think*, and therefore that machines can only work under human superintendence. In 1799, at a period when wages were high and work plentiful, a furious mob scoured the country round Blackburn, destroyed every jenny which worked more than twenty spindles, and demolished carding-engines, water-frames, and every machine worked by horses, or by water power. Mr. Peel, the grandfather of the present premier, who had abandoned his farm to engage in the cotton trade, was a severe sufferer on this occasion; his works for cotton-spinning and calico-printing at Altham were destroyed, the machinery thrown into the river, and his personal safety endangered. A mill which Arkwright had erected near Chorley, was pulled down in the presence of a large body of the police and military without any of the authorities interfering for its protection. It was useless for the injured parties to seek legal redress, for several powerful persons had combined to screen the rioters from punishment. Their motive appears to have been a dread that machinery, by superseding manual labour, would throw a heavy burthen on the poor-rates, and deteriorate the value of land in Lancashire. Experience has since shown that machinery increased the amount of employment more than twenty-fold, and it would not be easy to calculate how much the demand for building-ground has added to the rental of the landowners.

Blackburn long suffered from the pernicious effects of these outrages; the cotton manufacturers migrated to

other districts; and Blackburn, which bid fair to be the metropolis of the new trade, ceded its honours and advantages to Manchester. It is gratifying to add, that few traces of this hostility to machinery can now be found among the operatives of Lancashire; we have conversed with many operatives in the factories, both male and female, old and young; all were equally convinced that machinery ensured them steady employment and high wages. They reasoned thus:—when a large capital is invested, the proprietor cannot afford to let it remain idle; and he will pay high wages, both on account of the great amount of property he entrusts to those he employs, and because in a very large business wages bear but a small proportion to the amount of other expenses.

Having in a recent work* described the immense increase of the value of property which has resulted from the introduction of the cotton-manufacture into the county palatine of Lancashire, we shall not here repeat the statement, but shall extract a most graphic account of the changes in the village of Mellor, in Cheshire, about fourteen miles from Manchester, from the pen of Mr. William Radcliffe, the inventor of the dressing-machine. It will be the most appropriate conclusion to this chapter.

"In the year 1770, the land in our township was occupied by between fifty and sixty farmers; rents, to the best of my recollection, did not exceed ten shillings per statute-acre; and, out of these fifty or sixty farmers, there were only six or seven who raised their rents directly from the produce of their farms; all the rest got their rents partly in some branch of trade, such as spinning and weaving woollen, linen, or cotton. The cottagers were entirely employed in this manner, except in a few weeks in the harvest. Being one of those cottagers, and intimately acquainted with all the rest,

* Notes of a Tour in Lancashire.

as well as every farmer, I am better able to relate particularly how the change from the old system of hand-labour to the new one of machinery operated in raising the price of land. Cottage rents at that time, with a convenient loom-shop, and a small garden attached, were from one and a half to two guineas per annum. The father of a family would earn from eight shillings to half-a-guinea at his loom; and his sons, if he had one, two, or three, alongside of him, six or eight shillings each per week; but the great sheet-anchor of all cottages and small farms, was the labour attached to the hand-wheel; and when it is considered, that it required six to eight hands to prepare and spin yarn, of any of the three materials I have mentioned, sufficient for the consumption of one weaver,—this shows clearly the inexhaustible source there was for labour for every person from the age of seven to eighty years, (who retained their sight and could move their hands,) to earn their bread, say one to three shillings per week, without going to the parish.

"From the year 1770 to 1788, a complete change had gradually been effected in the spinning of yarns; that of wool had disappeared altogether, and that of linen was also nearly gone; cotton, cotton, cotton, was become the almost universal material for employment; the hand-wheels were all thrown into lumber-rooms; the yarn was all spun on common jennies; the carding for all numbers up to forty hanks in the pound was done on carding-engines; but the finer numbers of sixty to eighty were still carded by hand, it being a general opinion at that time, that machine-carding would never answer for fine numbers. In weaving, no great alteration had taken place during these eighteen years, save the introduction of the fly-shuttle, a change in the woollen looms to fustians and calico, and the linen nearly gone, except the few fabrics in which there was a mixture of cotton. To the best of my recollection,

there was no increase of looms during this period, but rather a decrease.

"The next fifteen years, viz. from 1788 to 1803, I will call the golden age of this great trade. Water-twist and common jenny yarns had been freely used in Bolton, &c., for some years prior to 1788; but it was the introduction of mule-yarns about this time, along with the other yarns, all assimilating together and producing every description of clothing, from the finest book muslin, lace, stocking, &c., to the heaviest fustian, that gave such a preponderating wealth through the loom.

"The families I have been speaking of, whether as cottagers or small farmers, had supported themselves by the different occupations I have mentioned in spinning and manufacturing, as their progenitors from the earliest institutions of society had done before them. But the mule-twist now coming into vogue, for the warp, as well as weft, added to the water-twist and common jenny yarns, with an increasing demand for every fabric the loom could produce, put all hands in request, of every age and description. The fabrics made from wool and linen vanished, while the old loom-shops being insufficient, every lumber-room, even old barns, cart-houses, and out-buildings of any description, were repaired, windows broke through the old blank walls, and all fitted up for loom-shops. This source of making room being at length exhausted, new weavers' cottages, with loom-shops, rose up in every direction; all immediately filled, and, when in full work, the weekly circulation of money, as the price of labour only, rose to five times the amount ever before experienced in this district, every family bringing home weekly, 40, 60, 80, 100, or even 120 shillings per week! It may be easily conceived, that this sudden increase of the circulating medium would, in a few years, not only show itself in affording all the neces-

saries and comforts of life these families might require, but also be felt by those who, abstractedly speaking, might be considered disinterested spectators; but in reality they were not so, for all felt it, and that in the most agreeable way, too; for this money in its peregrinations left something in the pockets of every stone-mason, carpenter, slater, plasterer, glazier, joiner, &c.; as well as the corn-dealer, cheesemonger, butcher, and shopkeepers of every description. The farmers participated as much as any class, by the prices they obtained for their corn, butter, eggs, fowls, with every other article the soil or farmyard could produce, all of which advanced at length to nearly three times the former price. Nor was the portion of this wealth inconsiderable that found its way into the coffers of the Cheshire squires, who had estates in this district, the rents of their farms being doubled, and in many instances trebled."*

* Origin of Power-loom Weaving, by William Radcliffe, pp. 59—66.

CHAPTER IX.

MECHANICAL PROCESSES OF SPINNING AND WEAVING

THE filament of silk is, as we have already mentioned, elongated and spun by the worm, and the only business of the throwster is to strengthen these filaments by twisting two or more of them together. Flax when cut differs little in outward appearance from the stems of other vegetables; in order to separate the fibrous filaments from the vegetable core the flax is either steeped in water or exposed to the weather until the vegetable matter undergoes a slight fermentation, which weakens its adhesive power. It is then dried and subjected to the action of an instrument called the *brake*, which crushes the vegetable matter into powder, and sets loose the fibres of the true textile flax. The fibres are then divided, cleaned and straightened by being drawn through heckles, or wire combs, with teeth of considerable length, and the process is several times repeated by hand, after which it is completed in the heckling-machine, which may be described as a cylindrical revolving card, supplied by young operatives, who fasten sticks or bundles of flax into a fixed holder, moving them at the proper time from the coarser to the finer heckle, inverting and turning them and replacing them when heckled by fine flax. The short fibrous matter heckled off from the flaxen locks is named tow, and requires an additional process before it is fit for the use of the spinner. Heckling is a fatiguing and dusty operation, and in addition to the annoyance which the tenters of the heckling-machine suffer from the particles of flax flying about, they are also exposed to injury from

the sharp teeth of the heckling-machine, from which they have to collect the tow while the spiked wheel is revolving.

The analogous process in the preparation of wool varies as the wool is long or short. Long wool is used in worsted factories; it is first carefully washed and dried, after which it is removed to a machine called "the plucker," which does not differ essentially from the willow used in the cotton-manufacture, which we shall presently describe. It is then taken to the wool-combers, who draw it by hand through heated combs, having teeth of considerable length. By this process the fibres of the wool are laid parallel, and the pliancy and ductility of the filaments are greatly increased by the heat of the combs. This is a very fatiguing and unpleasant process to the workman on account of the great heat of the room in which it is conducted, and it has been superseded by mechanical contrivances in several large factories.

The wool when combed is removed to the "breaking-frame," which is, in fact, a species of carding-engine, by which the fibres of the wool are further straightened, and drawn close together, so that they are delivered from the machine in the form of a soft riband, or sliver, which is made to wrap itself round a cylinder or large bobbin.

The machines for the preparatory processes used in the manufacture of short wool, for fabricating cloths, flannels, &c., do not differ very much from those employed in the cotton manufacture; and as they were borrowed from the cotton processes, it will be more convenient to describe them as applied to cotton, noting the differences arising from the staple of the several materials.

The relative value of raw cotton depends on the length of its staple, the delicacy of its fibre, and its freedom from dirt and seeds. An unpractised eye does not easily detect the differences which a manufacturer

perceives at a single glance, and one is apt to conclude that in the sale of cotton there is great scope for fraud, by mixing the inferior kinds with those of superior quality. On inquiry, we were informed that there were many opportunities for such deception, but that it was rarely if ever practised. Raw cotton is sold by sample, and so high is the sense of commercial honour among the cotton dealers, that a contract is rarely voided by supplying an article inferior to the sample. Previous to the opening of the railroad the cotton dealers formed an important part of the merchants of Manchester, but since that period many manufacturers prefer making their purchases in Liverpool.

However careful the Americans may be, cotton never comes to England in a state fit for immediate use; some seeds remain after the most careful cleaning, and the pressure to which it is subjected in packing, forms hard matted lumps, and some of the coarser and heavier wool is unavoidably mixed with that of superior quality. The first operation in the process of manufacture is consequently the cleaning of the cotton. It is put into the blowing-machine, where the cotton is torn open by revolving spikes, and subjected to the action of a very powerful blast, produced by the rapid turnings of a fan; the light wool is thus blown to some distance from the heavier portions, the dirt, seeds, &c. This process is continued in the scutching-machine, where the cotton is beaten by metallic blades making from 3000 to 5000 revolutions in the minute; these completely open the fibre, and separate the fine wool from the waste, which falls to the ground through a frame of wire-work.

The cleaning process is generally called "willowing," which is either a corruption of *winnowing*, or perhaps derived from the willow frames on which the cotton was cleaned by beating, before blowing-machines were invented. Previous to this improvement the cotton was placed upon willow hurdles, or upon cords stretched over a wooden frame, and then beaten with smooth

switches. This operation, technically called *batting*, though very fatiguing, and we believe unwholesome, from the dust, &c., which was scattered about, was usually performed by women: it is now very rarely practised, except when some remarkably fine cotton is required for the manufacture of lace, when it is of importance to preserve the length of the staple, which might be injured by machinery.

The Hindoos open the fibres of their cotton by a bow similar to that which hatters use in raising wool; the same contrivance appears to have been employed in America, for we find the term "bowed cotton" still employed in the language of commerce. Judging from its effects on wool and fur, we should think that the bow is an effective machine for cleaning and opening the fibres, but it would be far slower and less productive than the willow.

When cleaned, the cotton is brought to the lapping or spreading machine, where a given weight of the wool is spread over a determinate surface of cloth, and being then slightly compressed by a cylinder, it is lapped round a cylindrical roller so as to be in a fit state for feeding the carding machine. It is a singular fact, illustrating the accuracy with which machinery works, that the weight of the cotton spread on the cloth in this process regulates the fineness of the thread ultimately produced, and that there is rarely any great amount of error in the calculation.

Animal fleeces, from the quantity of oil secreted in them, are far more likely to mat their fibres than any vegetable wool, and hence they are always used in the process of felting. This is just the converse of the requisites for the purpose of spinning, and hence nobody ever expects to derive so fine a yarn from wool as from cotton; for the same reason the processes applied to short wool are coarser than those in the analogous stages of the manufacture of cotton. The "willy," or "willow," used for animal wools is not a mere blowing-

machine; it is further armed with spikes for the purpose of tearing the matted masses of wool in sunder, and is altogether so terrific in its appearance, that it usually bears the appellation of "The Devil." It must be added that the terrors of the said "Devil" exist only in appearance, for it is as little dangerous to its tenters as a grindstone or a smokejack. Blowing and lapping machines have not been introduced into the woollen manufacture, nor are they likely to be so, because no animal production can ever be spun into very fine yarns.

Scribbling is an operation preliminary to carding, and identical with it in principle. In cotton, the great object is to turn out the material perfectly dry; but in the later willowing operations, and the *scribbling* of wool, the filaments are thoroughly saturated with animal oils, which are made to penetrate their entire substance. On this account, the rooms for the preparation of wools are more uncleanly and unpleasant in smell than those where the earlier processes of the cotton manufacture are conducted; but it is commonly observed that all persons engaged in these woollen processes become remarkably healthy, ruddy, and robust.

We have already described the construction of the carding-engine as used in cotton-factories, with its beautiful contrivance of the crank and comb. Nothing, however, but absolute inspection and close examination of the machine can convey anything like an adequate idea of its merits. The successive cards on the concave and convex cylinder are seen to subject the wool to several successive cardings at each revolution of the wheel; and, to prevent the necessity of stopping the machine to remove the carded cotton, it is stripped off by the doffer, which removes the cotton, not in successive portions, but in one continuous fleece. Again, the removal of this fleece from the doffer, which would be both tedious and imperfect if attempted by hand cards, is completely accomplished by the simple agency of the crank and comb.

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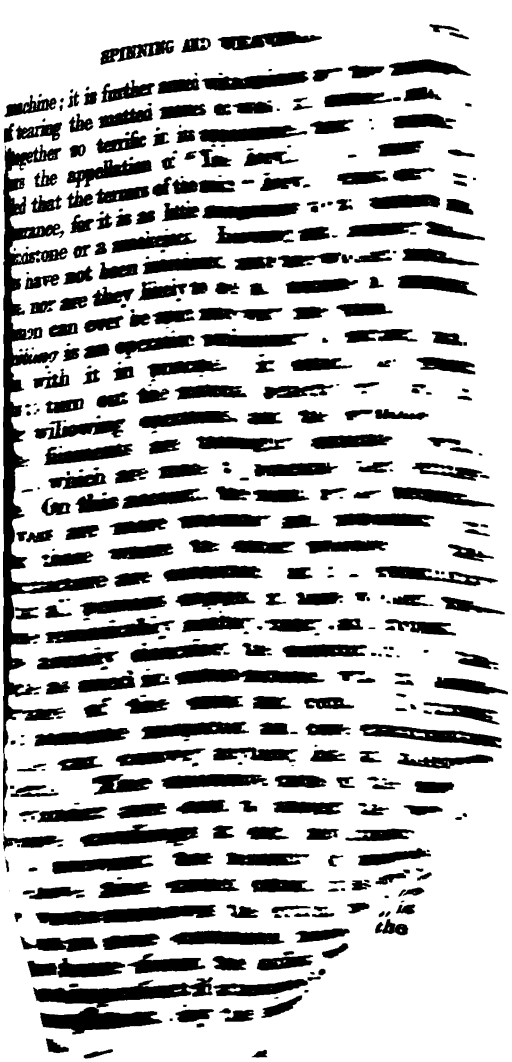

spinning in a carding machine similar to that used in the cotton manufacture. This process is rendered very unpleasant by the quantity of dust thrown off from the vegetable matter adhering to the flaxen fibres. In the latest flax-carding machines every precaution, which the nature of the material will admit, appears to have been taken for the purpose of preventing this nuisance of dust, and it certainly has been to a considerable degree abated, but as certainly it continues to exist to a very annoying and injurious extent, nor is it easy to conceive how a remedy can be applied, for the particles of vegetable core adhere too strongly to the fibres of the flax to be separated by the most powerful blowing-machine that can ever be devised, and it is clearly impossible to make a blower work simultaneously with a carding engine. The best plan which we have seen for counteracting the nuisance is simply the enclosure of each separate flax-carding engine in a species of tent; the cotton-apparatus and suction pipes recommended by Doctor Ure have only the merit of being supremely ridiculous.

Carding is not the only operation employed to straighten the fibre of the cotton. It may easily be conceived that the teeth of the cards will frequently lay hold of a fibre by the middle, and thus double it together, in which state it is unfit for spinning. This evil is corrected in the drawing frame—an important part of the spinning machinery—for it executes work which could scarcely have been effected by human hands. The essential parts of the drawing frame may be easily understood from description. Each drawing head consists of three pairs of rollers; the upper one of each pair being smooth and covered with leather, the lower being fluted longitudinally. They are placed at a distance from each other, which is regulated by the staple of the cotton; that is to say, the distance between each pair of wheels is generally a very little more than the length of the fibres subjected to their action. The loose riband formed

by the carding-machine is pulled through these rollers, and as they revolve with different velocities the fibres pull out each other, and reciprocally extend each other to their full length. But a not less important object of the drawing frame is to equalize the consistency of the cardings. One carding, notwithstanding all the precautions that have been taken, will be found to have more or less of substance than another, and it is necessary to counteract this inequality by combining several of the carded ribands, technically called "card-ends," into one sliver. Eight card-ends are usually brought to the first drawing head, and after passing through the rollers they combine to form one sliver of the same density as each of them separately, thus increasing eight-fold the chances of uniformity in the sliver. Four of these slivers are again subjected to the same process, and thus the chances of uniformity are thirty-two fold those of the original card-ends; and this is continued until the last sliver may be regarded as containing parts of 300 card-ends: but for very fine spinning, the doubling of the fibres, as the process is called, is multiplied more than 60,000 times,

The drawing-frames are fed from the tin cans containing the card-ends, and the chief duty of those who attend them is to mend or piece the feeding slivers when one of them is broken, or when one of the cylindrical cans is exhausted. A contrivance has been recently introduced to abbreviate this labour; a cylindrical weight is made to fall at intervals into the receiving can, and, by pressing down the sliver, to force it to hold more than double the quantity which it would contain if the sliver were left to coil itself loosely. In the mills for fine spinning great attention is paid to this process, because any defects left by the drawing frame cannot be cured in subsequent operations. The labour of attending to the machines is the lightest in the cotton mill, but there are few parts which require more vigilance and care.

As a casual visitor is very likely to pass by a drawing-frame without perceiving its construction, it may be well to mention, that there is a mahogany bar faced with flannel over every drawing head, and a similar bar pressed gently by a weight against the lower tier of rollers; these remove all loose fibres, and it is necessary to displace the upper bar in order to see the action of the machinery.

The next operation is the making of a roving or thin sliver, about the thickness of candlewick, and giving it only so much of a twist as will enable it to hold together. The attenuation of the sliver is accomplished by rollers acting in the same way as in the drawing process; but various contrivances have been devised to give the roving just so much tension as is necessary and no more. Arkwright invented the can-roving frame, in which a slight twist was given to the roving by making the receiving can revolve upon a pivot. It was necessary that the rovings after this operation should be wound off upon bobbins, a process injurious to their delicate texture; to obviate this evil, the jack-frame, or jack in the box, was contrived, which wound the roving on a bobbin as it received its twist instead of leaving it to coil in the can. At present the process of roving is generally performed by the bobbin and fly frame, an ingenious but complex piece of mechanism, though its principles admit of easy explanation.

Two objects are to be effected: first, the roving is to receive a slight twist, and, secondly, it is to be then wound on the bobbin. For the first purpose the motion of the spindle is sufficient,—the chief difficulty lies in effecting the second. The sliver passes from the roller to the bobbin through the hollow arm of a flyer attached to the spindle, the other arm of the spindle is solid, and serves only to balance the machinery. In the most perfect spindles there is a brass ring attached to the end of the hollow arm of the flyer, acted upon by a spring for the purpose of compressing the roving; there is also

a delivering finger, round which the roving takes a turn which prevents its being improperly stretched by the centrifugal force produced by the rotation of the flyer. The amount of twist given to the roving depends upon the ratio between the speed of the roller by which it is delivered and that of the spindle, and this ratio, of course, is invariable during the process. The winding-up however presents many difficulties: the delivering finger of the flyer must glide up and down under regulated pressure, so as to lay the roving evenly over the entire surface of the bobbin; and as each coil of roving increases the periphery, or thickness, of the bobbin, there is a necessity for a corresponding change of motion to accommodate the receiving powers of the bobbin to the quantity of roving given out by delivering the arm of the flyer.

Were the bobbin at rest, every revolution of the spindle would wind round it a length of roving equal to its circumference; but as the revolutions of the spindle are determined by the degree of twist necessary to be given to the roving, and not by the amount which the bobbin can take up at each revolution, it becomes necessary to make the bobbin revolve in the same direction with the flyer, but at a speed so much less as will enable it to take up the exact amount of roving given out by the feeding rollers. Suppose that quantity to be six inches, and that thecir cumference of the bobbin is at the same time six inches, if the spindle makes nine revolutions while the bobbin makes only eight, it will have gained one revolution, and by that means will have wound round the bobbin the exact quantity of roving issued by the delivering rollers; now, as the circumference of the bobbins is constantly increased by the roving wound upon it, there is a perpetually recurring necessity for a series of adjustments, which were found in practice to be beyond the capacity of the persons employed to superintend the working of these frames. The thicker that the bobbin becomes in consequence of the roving

wound upon it, the more must its motion be increased in order to diminish the difference of velocity between it and the spindle: this is effected by causing the driving-strap to act on a conical, instead of a cylindrical drum, thus giving to the movement a variable instead of an equable velocity. It is not necessary to enter into any examination of the many ingenious contrivances which have been devised to render the roving machines more perfect and automatic; the reader will appreciate the difficulty of the operation by bearing in mind, that the process of twisting by the spindle, and winding on the bobbin, though connected in fact, are quite independent in principle, and that there is therefore a necessity for the nicest adjustment, in order that the one should be accommodated to the other.

It may be noticed that two slivers from the drawing-frame are combined in a roving, and consequently that we are, after this, to double the amount of the combinations from the original cardings. We may add, that the compressing apparatus attached to the delivering arm of the flyer is not yet universally used, but is chiefly found in new mills. The roving process is repeated for the finer kinds, or, as they are technically called, the higher numbers, of yarn. When it is completed, the rovings are taken to be spun either by the throstle or the mule; but the rovings for the higher numbers are previously worked on the stretching frame, which in all its essential parts is the same as the mule, and may therefore be included in the description of that machine.

The drawing-frame and doubling apparatus in spilling the long-wool or worsted are constructed on the same principle as the machines used in the cotton-manufacture, except that, in the former, the distance between the first and last pair of rollers is much greater than in the latter, on account of the greater length of the wool-staple. The "roving-frame" for worsted is also of simpler construction than the bobbin and fly-frame, and the worsted is finally spun into yarn by the "throstle," which is the

machine also used for spinning cotton-yarns of low numbers. We were informed that it was in the worsted trade, that this machine first received the name of "throstle," from its singing noise, which is indeed "most musical, most melancholy." The worsted throstle differs from the drawing-frame in having four pair of rollers instead of two, and in not repeating the doubling operation, there being one bobbin of rolling fixed in the reel for each spindle in the copping-rail.

Short-wool spinning is sometimes performed by the jenny, but in most large mills by the mule, which will be more appropriately described in connexion with cotton. Flax-line, that is heckled-flax freed from the tow, and sorted acording to its various degrees of fineness, is spun nearly in the same way as the long-combed wool, but it is necessary that the rovings on their way between the delivering bobbins and the spindles should pass through water, which is now usually heated and supplied in covered troughs. Notwithstanding every precaution, a dewy spray is constantly thrown off by the yarn as it is rapidly turned by the flies of the spindles, and this produces a very serious inconvenience when the spinning-frames are placed very close together; but in the modern flax-mills a sufficient space is left between the frames, and several minute contrivances are introduced to lessen the amount of spray dashed about by the flyers. The dust from the carding-engines and the water from the spinning-frames render flax-factories more objectionable than cotton or woollen-mills, but the evils both of the dust and water have been greatly exaggerated, and mechanical ingenuity is constantly at work to apply remedies to the existing inconvenience. We must in justice add that, before visiting the flax-mills, we had been led to believe from common fame and from various reports, that they were the worst-conducted of all the spinning-factories, and in particular that they were the most exposed to accidents from machinery. It is true that the flax-carding engine is both more formidable in

appearance and more dangerous in reality than that used in the cotton-manufacture, and were they placed very close together, the lanes between them would require to be traversed with some caution; but some of the latest carding-engines which we have seen are not dangerous, and certainly all the new flax-mills are constructed on the principle of allowing the most ample space for the machinery. We have already mentioned that the flax-carding engine is used only for the tow; it only remains to add, that the tow-rovings are roved by a bobbin and fly, precisely similar to that which is used in the cotton-manufacture, and that it is spun by the throstle, generally with a wetting apparatus, but sometimes without any application of moisture.

Mule-spinning belongs both to the cotton and to the short-wool manufacture, but in the former is both more extensive and more interesting.

Let the reader imagine himself in the room, a part of which is represented in the accompanying cut, (*see frontispiece,*) and it is probable that the circumstances worthy of his notice will present themselves in nearly the following order. He will see a carriage about a yard in height, and of very considerable length, varying in different mills, bearing a row of spindles between its upper rails; it has generally three wheels, which traverse on the same number of iron guiding bars, so as to allow of its drawing on, to a distance of more than four feet from the stationary frame; as it recedes from the frame, it draws with it, and elongates the threads or rather rovings delivered to it through rollers, by a series of bobbins in the creels or stationary rails. The threads as they are elongated are twisted by the spindles, and should any of them break, it is the duty of a boy or girl, called a piecener, to join the disunited ends as the carriage moves from the upright frame. A girl in the act of piecing the yarn is represented in the cut. When the carriage has receded to its full extent, the spindles continue to revolve until the requisite quantity of twist is communicated to the yarn. The spinner then causes

the spindles to revolve backwards until he has unwound the portion of thread which has coiled spirally round it from the point to the nose of the cop, and at the same time he lowers a faller wire, supported by hooks, as seen in the cut, so as to regulate the winding of the yarn on the cop in a proper spiral. There is great nicety required in regulating the pushing back of the carriage, for it is necessary that its rate of travelling should be commensurate with the revolution of the spindles. Three simultaneous and delicate movements have thus to be effected by the spinner as the carriage returns; he must guide the faller wire so as to ensure the regular winding of the yarn on the cop; he must regulate the rotation of the spindles, of which there are often a thousand to one mule; and he must push the carriage at such a rate as to supply precisely the exact amount of yarn that the spindles can take up.

The little piecener can only take up the ends when the carriage is within a foot or two of the delivering roller, and they have therefore an interval of rest while the carriages traverse backwards and forwards. The spinner too has a brief respite while the carriage is moving outwards from the frame. The time taken to make a stretch, that is, to draw out a thread equal in length to the range of the carriage, increases with the fineness of the yarn, and varies also according to the completeness of the machinery and the skill of the operative. The breaking of the threads depends not merely on the machinery, but to a very great extent on the atmosphere and temperature. We were in a mill during the prevalence of a sharp drying east wind and found that it produced such an effect on the fibres of the cotton, that the threads broke faster than the piecener could mend them, and that the spinning of very high numbers at such a time was all but impossible. The rooms in which fine yarn is spun are kept at a temperature of from 70° to 80°, which is not so high as to produce much inconvenience.

It is obvious that the spinner is a very important

workman when such mules as that we have described are employed: on him depend not merely the machinery and its work, but the employment of the young piecener and the "scavengers," or "cleaners," who are constantly employed in removing the waste cotton or "fly," as is shewn in the cut. The spinners knew their strength, and, though they received very large remuneration, frequently turned out for higher wages, by which they not only threw their assistants, the piecener and cleaners, out of employment, but also the operatives engaged in the several processes for preparing the cotton previously to its being spun. To remedy this evil, many attempts were made to construct self-acting mules, that is, mules which would not require the attention of a spinner, but could be wholly managed by his subordinates. Mr. Roberts, as we have before mentioned, of the firm of Sharp, Roberts, and Co., was the first, and is still the only inventor that can be said to have succeeded in this desirable object; his self-acting mules are very generally used in the mills where low numbers are spun, but we believe that they have not been found applicable to the spinning of the finer yarns. After being spun, the yarn, if not destined for weft or doubling, is wound off on a hexagon reel, one yard and a half in circumference; the reel strikes a check after every eighty revolutions, which form what is called *a ley*, that is, 120 yards of yarn; seven leys form a *hank* of 840 yards of yarn, as has been already stated, and the fineness of the thread is known by the number of these hanks that weigh a pound.

The hanks of yarn are ranged according to their numbers, and are packed in cubical bundles of from five to ten pounds' weight. These packages are closely compressed by a simple machine called the bundling-press, and being neatly wrapped in paper are ready to be sent to market.

The yarn designed for making bobbin-net lace and the finer species of hosiery, is subjected to another process called gassing, which is in fact the singeing off of the

loose fibres, or any other unevenness of the thread, by a flame of gas. The machine consists of a series of jet flames of gas, through each of which the thread passes several times with a velocity proportioned to the number of the yarn. The machinery is set in motion by the winding and unwinding of bobbins, each of which revolves from 2000 to 3500 times per minute. Each thread passes through a cleaner, slit in a lever, and when a knot or rough point occurs too large to pass through the slit, the whole mechanism for singeing and winding that thread is thrown out of gear by the jerk given to the lever. The attention of the gasser or tenter of the machine who is generally a female, being thus directed to the defect, an instant remedy is applied without stopping the action of the rest of the machinery.

The ashes of the fibres singed off form a red and almost impalpable powder like Spanish snuff, which it would be perilous to inhale; the operation is therefore conducted in a room protected from the effects of sudden draughts by double doors and a long entrance passage secured by an additional door. The gassing process is usually carried on in a detached building, partly to prevent the danger of fire, and partly to guard against any disturbance by the opening or shutting of doors.

Yarn is formed into thread by the doubling process: two or more mule spindle cops, or throstle bobbins, deliver their yarn through a pair of rollers to a spindle and fly, similar to that of the common throstle, which twists the double yarn in a direction opposite to the twist which the yarn received in spinning. The operation is usually facilitated by previously passing the yarn through a weak solution of starch, which renders it more tenacious and compact. Doubling, until within the last few years, was a business distinct from spinning, but it is now common in the mills where high numbers are spun. The process is most delicate when applied to the very fine yarns used in the manufacture of lace, varying from

number 140 to number 350, the extreme delicacy of which requires the most tender manipulation.

A hank of worsted-yarn usually contains four hundred and sixty yards, and it is divided into seven leys of eighty yards each; but in Lancashire it is common to reckon by the hank of eight hundred and forty yards, as in cotton-yarn and linen thread. The short-wool yarns are usually woven in the same factories in which they are spun. The mule used for spinning woollen-yarns has but one pair of rollers, and the principal care of the spinner is to regulate the faller wire, so as to ensure the regular winding of the yarn on the cop. Two qualities of yarn are required for every species of cloth, whether woollen or cotton; that which is strongest and most firmly twisted forms the warp; that which is of a softer and more spongy texture forms the weft, and these are always carefully distinguished in commerce. It has been already mentioned, that a similar distinction exists between organzine and tram in the silk trade. We need only add, that the processes for spinning the refuse of thrown silk are the same as those applied to tow, which we need not repeat, is a similar refuse from the superior flax-fibre.

Having now reached the conclusion of the spinning processes, it will be convenient to recapitulate them briefly, and point out the general principle that pervades the whole. In all the machines, from the carding-frame to the mule, it will be seen that cotton or short wool is continually attenuated by being passed through rollers, until a roving is made perfectly even and continuous, after which it receives the torsion or twist that makes it into yarn. The card end is like a thick rope, which is reduced more and more as it passes through each successive system of rollers, until it becomes as fine or even finer than a human hair. It is precisely on the same principle that plates of metal are made smooth and thin, by being passed through successively several systems of cylinders. Before the invention of spinning by rollers,

this process of attenuation, now so complex, was effected by the finger and thumb of the spinner. Hence arose the great superiority of the Hindoos, especially in the finer fabrics, such as muslins; they possess a delicacy of touch, which apparently compensates for their want of muscular strength, beyond any other nation on the face of the earth. We possess a piece of Dacca muslin woven of hand-spun yarn, and it requires the assistance of the microscope to discover that the sensitive fingers of the Hindoo spinner have failed to produce a thread equal in evenness and regularity to that wrought by the multitudinous rollers of a Manchester factory. The use of rollers is confined, of course, to the filaments of short staple; they are not at all required in silk throwing, and they are used only to a limited extent in the preparation of worsted and linen yarns.

It will be seen that it would be utterly impossible to conduct these several processes anywhere, except in a large building erected especially for the purpose, or, in other words, that spinning machinery could be used only in a mill or factory. The materials, after passing through any one of the successive operations, would be exposed to serious injury if it was necessary to transport them to any considerable distance, to say nothing of the temptations to which the operatives would be exposed, and to which they notoriously yielded when spinning was a domestic operation. It is also to be remembered, that the fatiguing part of all these processes is performed by power; the machinery is the servant and the assistant of the operative; it performs every labour that is at all toilsome or burthensome; it saves every expenditure of muscular strength and physical energy, requiring from him only the mental exertion necessary for the superintendence of its operations. The principal agents from which power is obtained are fire and water,—proverbially the best of servants and the worst of masters. In no part of the world are those agencies more abundantly supplied or more actively employed than in the

tract between the Ribble and the Mersey, and the adjoining districts of Lancashire, Derbyshire, and Cheshire. South Lancashire has an abundance of rich coal-fields, sufficient to supply the consumption of its steam-engines for uncounted generations; the neighbouring county of Stafford furnishes it with abundance of iron, and its great sea-port, Liverpool, enables it to import the raw materials, and to export in its turn its beautiful fabrics, receiving for them in payment as much of the necessaries and comforts of life as the fiscal regulations, or the prohibitory duties, imposed by government for the protection of favoured classes, will permit them to accept. High ranges of hills bound South Lancashire on the east and north; there are also elevations of considerable extent in the hundreds of Blackburn and Salford. The district is in consequence intersected by great numbers of streams and streamlets, which supply water to many hundreds of mills. The river Irwell—the hardest worked river in the universe—besides washing, bleaching, dyeing, &c., is calculated to move, with its tributaries, not fewer than three hundred water-wheels, some of which are of the most stupendous dimensions.

But these natural advantages would have been of little avail without the untiring energies, indefatigable industry, and inventive genius, of the men of Lancashire. It was to these qualities that M. Charles Dupin justly attributed the decisive triumphs of English manufacturers, particularly in their last and greatest achievement, the fabrication of the varied diversities of cotton goods. It was to the emulation of these qualities that he stimulated the mechanics of Paris, in his celebrated address, from which we extract the following eloquent tribute to English skill and perseverance:

"Watt improves the steam-engine, and this single improvement causes the industry of England to make an immense stride. This machine represents, at the present time, the power of three hundred thousand horses, or of two millions of men, strong and well-fitted for labour, who

should work day and night without interruption, and without repose, to augment the riches of a country not two-thirds the extent of France. A hair-dresser invents, or at least brings into action, a machine for spinning cotton; this alone gives to British industry an immense superiority. Fifty years only after this great discovery, more than one million of the inhabitants of England are employed in those operations which depend, directly or indirectly, on the action of this machine. Lastly, England exports cotton, spun and woven by an admirable system of machinery, to the value of four hundred millions of francs yearly. The Indies, so long superior to Europe—the Indies, which inundated the west with her products, and exhausted the riches of Europe—the Indies are conquered in their turn. The British navigator travels in quest of the cotton of India,—brings it from a distance of four thousand leagues,—commits it to an operation of the machine of Arkwright, and of those that are attached to it,—carries back their products to the East, making them again to travel four thousand leagues;—and, in spite of the loss of time, in spite of the enormous expense incurred by this voyage of eight thousand leagues, the cotton manufactured by the machinery of England becomes less costly than the cotton of India spun and woven by the hand near the field that produced it, and sold at the nearest market. So great is the power of the progress of machinery."*

* Address of M. Charles Dupin to the Mechanics of Paris.

CHAPTER X.

MECHANICAL PROCESSES OF SPINNING AND WEAVING, CONTINUED.

In describing the processes of weaving we shall principally direct attention to those employed in the cotton manufacture, indicating only the more marked and prominent variations required for silks, linens, and woollens. It is in the cotton trade that power-looms are most extensively used; and indeed to most of the large mills, where very high numbers are not spun, a power-loom shed is attached; and when its door is opened, the aggregate of rattling shuttles salutes the ear with a noise which may give a visitor no bad idea of the roar produced by the falls of Niagara.

The first step in the process of weaving is the formation of the *warp*, that is, the longitudinal threads of the web which lie parallel to each other through the breadth of the cloth. Warp-yarn, or twist, is more firmly twisted and harder than the *weft*, which is shot through it horizontally by the shuttle; and hence we find in the economy of Indian manufactures, that the warp-yarn was usually prepared by the Mohammedans and weft by the Hindoos. The warp-yarn is wound from off the cops of the mule, or the bobbins of the throstle, on very large bobbins, by means of the winding-frame. The threads pass through glass hooks fixed on the guiding-frame, which traverses laterally to the right and left, so as to distribute the yarn evenly over the surface of the bobbin. In this operation the yarn is passed through water to increase its tenacity.

The bobbins are then transferred to the warping-mill, and their yarns are wound off on a wooden cylinder. The working of the warping-machine requires very little

explanation. As the yarns are unrolled from the system of bobbins, they pass over and under a set of cylinders which bring all the threads into one horizontal plane; they are then conducted through guide-wires, fixed like the teeth of a comb to the receiving cylinder, which, in addition to its rotatory motion, is capable of being raised or depressed as the diameter of its barrel is increased or diminished by the winding on or off of the yarn. Great care is requisite in this process to take up and join any threads which may be accidentally broken; hence the machinery is painted black, so that the warper, usually a female, can at once perceive the deficiency of any of the white threads on the dark ground. If she allows a broken thread to escape, she must unwind the warp again until she discovers it; and though machinery is provided to facilitate this process, and prevent any of the other threads receiving injury while she is searching for the broken thread, yet there is much delay if the unwinding has to go far back,—and as the warper is paid by the piece, neglect or delay sadly impairs her wages. Though this is really a very simple process, yet it is one which always attracts the notice of strangers, because the number of bobbins giving out yarn from the bobbin-frame produces a very pleasing pictorial effect. The simplicity of the mechanism does not, however, diminish the interest of the operation. A visitor who is anxious to witness skill and training in the attendant, as well as power and ingenuity in the machine, will be struck with the extraordinay vigilance and quickness of sight displayed by the warper. Though perhaps a thousand threads are winding before her, if one, whether near or remote, should happen to break, she at once throws the machinery out of gear, and proceeds to piece the ends together. In the warping-machine, the entire warp is distributed on eight cylinders, and from them it is rolled upon a single cylinder in the dressing-frame.

In the dressing-frame, the warp is wound from the

eight cylinders on to the weaving-beam. In its progress it passes through a warp reed of brass wires, and by means of a small roller is spread into a horizontal plane. Sizing, that is, paste or starch, is then applied to it by a cylinder turning in a wooden trough filled with cold paste, the superfluous moisture is squeezed out by the action of a second cylinder, and the moisture which it had imbibed with the sizing is squeezed out; as the warp advances it passes between flat brushes, so constructed that they only touch the yarn in one direction of their movement. In some dressing-machines two cylinders covered with brushes, one over and one under the warp, revolve in a direction contrary to that of the yarns. In many modern factories the dressing-frame has been superseded by the sizing-machine, which, by means of rollers, forces the fluid size to penetrate thoroughly the fibres of the yarn. When the warp has been thoroughly impregnated with the dressing by one of these processes, it is dried by being passed over a series of tin cylinders heated by steam, and the process is accelerated by a fan of three wings, which directs a powerful stream of hot air against the warp. When dry, the threads pass through a system of looped twines, called heddles, and through a reed to the weaving-beam. The dressing-machine is double, four warping-cylinders giving out the yarn at one end, and four at the other, but the threads from both pass through the same heddles and reed to the weaving-beam.

Large quantities of flour are consumed in the dressing operation; and, therefore, the laws which restrict the importation of corn impose in this case an onerous tax on the raw materials of manufacture. It is understood, however, that the duty would be remitted if any means could be devised by which the flour imported for dressing-machines could be rendered unfit for human food; just as the butter which comes in free of duty, for smearing sheep, &c., is rendered uneatable by being mixed with tar. No safe means, however, of thus

damaging or poisoning the flour have been yet discovered; and the cotton-manufacture is thus subjected to a tax on raw material, which has no compensating benefits to atone for its obvious injustice and impolicy.

The general outline of the process of weaving has varied little from the earliest ages, and is, probably, familiar to most persons. It will, however, be necessary to notice some of the special details; and, before doing so, it is of importance to understand the essential principles of the process, which may be best explained by a reference to the common loom.

The warp is wound round a weaving-beam placed at the extremity of the loom, remote from the operative. The alternate threads of the warp are kept separate by rods, and each alternate set of warp-yarns passes through a heddle. In very complicated work, several heddles are employed, but only two sets are used for the weaving of common cloth. Heddles are thin slips of wood, from which twines looped in the middle are suspended, through which the warp-yarns are alternately drawn, half through the front, and half through the back heddle. They are so suspended from the framework of the loom as to be alternately raised or depressed by treadles, or levers, connected with the heddles, which the weaver moves by the pressure of the foot. In front of the heddles is a light wooden frame suspended from the top of the loom, so as to swing freely; this is called the batten, or lay. The lower bar of this frame is the reed, an oblong frame, divided into numerous compartments by brass or iron wires fixed at equal intervals. These divisions were formerly made of split reeds, and hence the instrument takes its name. One thread of the warp passes through each interval or dent of the reed. In front of the weaver is the cylinder round which the cloth is wound as fast as it is woven. The weaver is provided with a shuttle, which is shaped like a canoe, and holds within it a cop or bobbin of weft yarn, which revolves, and gives out

thread as it is wanted through a hole in the side. This is placed between the alternate yarns of the warp, and a string being fastened to each end, in the middle of which is a kind of handle called the picking-peg, it can be shot backward and forward by a jerk.* The weaver, sitting down at the front of the loom, presses with one of his feet on the treadle, which brings down the corresponding heddle, with its share of warp, and raises the other. He then, by a smart jerk, drives the shuttle between the warp-yarns from one side of the loom to the other, and the cop of yarn within the shuttle gives out a shoot of weft in its passage. He then depresses the other treadle, which of course reverses the position of the heddles, and then yarns and jerks the shuttle back again, throwing out in its passage a second shoot of yarn. After every cast of the shuttle he pulls toward him the batten, or lay, with its reed, which drives home to the rest of the web the weft-yarn given out by the preceding casts of the shuttle. As the web is woven it is wound off on the cylinder.

The fineness or coarseness of the web is obviously measurable by the number of dents in the reed; and it is equally obvious that any irregularity in the intervals between the dents would produce an unsightly inequality in the cloth. Hence the reedmaker is a very important mechanist in furnishing the implements for weaving, particularly for very fine and close textures. A very ingenious machine for the construction of reeds has been recently made by Mr. Chapman of Manchester. It supplies the wire, cuts it to the requisite length, fixes and binds it at the required intervals with the most perfect accuracy, and performs all this with a rapidity and precision which can scarcely be surpassed by any other machinery. As it is necessary that the wires for the dents should be of equal thickness throughout,

* The shuttle was originally thrown by hand; "the picking-peg" was invented by Mr. John Kay, of Bury, in 1738, as already mentioned.

the machine draws and flattens the wire through cylindrical rollers; and there is a contrivance for throwing the machinery out of gear when any imperfection or inequality occurs in the wire. The mode of counting the dents in a reed varies in different localities. Mr. Chapman distinguishes his by the number of a hundred dents in a yard. He showed us one reed which contained the amazing number of 4800 dents in the yard, that is to say, 133 in an inch — so that his machine had actually made 266 divisions of a single inch, mathematically exact, both in parallelism and equality.

In order that the weaving should be perfect, great care is necessary in all the preliminary arrangements of the warp-yarn, which must be extended on the loom in parallel lines, and with an equal degree of tension. The rods which separate the alternate threads, technically called lease-rods, are to be set so as to keep the threads which are to go through one heddle quite distinct from those belonging to the other. Having received his yarn in a bundle, the weaver first rolls it regularly on the yarn-cylinder, keeping the threads distinct by an instrument called a ravel, which is in fact a coarse kind of reed. After the warp is wound on the cylinder, the operation of "drawing-in" commences; that is, the alternate threads are to be drawn through their respective healds, or heddles, and all the threads through the dents of the reed. The instrument used in this process is called a sley, or reed-hook, and is so constructed as to take two threads through every dent, or interval, of the reed. In reeds of very high number, for weaving the finest muslins, the "drawing-in" is an operation of great nicety, requiring both sharpness of sight and delicacy of manipulation; and the reed-hooks employed are made of the finest and best-tempered steel; but in ordinary cloth the process is simple, and is usually performed by women.

The lease, or separation of the alternate threads in the warp-yarn, is made by the pins in the warping-mill, and is preserved by the lease-rods. These rods, being

tied together at the ends, secure the permanency of the lease, and guide the operative in drawing the alternate yarns through the heddles. To facilitate the process, the beam on which the warp-yarn has been wound is suspended a little above the heddles, so as to allow the yarn to hang down perpendicularly. The operative then opens the loop in each of the twines of the heddles successively, and through each draws a warp-thread. This is, therefore, an operation not very unlike threading a needle, having its eye in the middle instead of the end. After the threads have been passed singly through the loops or eyes of the heddles, they are drawn in pairs through the dents of the reed. The heddles are then mounted with the cords by which they are moved, and the reed being placed in the batten, everything is ready for the weaver to commence his operations.

The power-loom is now generally used for the weaving of plain cloth, and for various kinds of twilled and figured goods. Mr. Roberts is the patentee of the power-loom most commonly used; but many other mechanists have produced various contrivances for weaving by machinery; and there can be no doubt that manual labour, at least for the coarser kinds of goods, must rapidly fall into disuse. In one respect, the power-loom has a very obvious advantage over the hand-loom: the batten, lay, or lathe, to which the reed is attached, drives home the weft to the rest of the web after it has been shot from the spindle; now a weaker or stronger blow of this lathe alters the thickness of the cloth, and, after any interruption, the most experienced weaver finds it difficult to commence with a blow of precisely the same force as that with which he left off. In the power-loom the lathe is easily adjusted to give a steady, certain blow; and, when once regulated by the engineer, it moves with unvarying precision from the beginning to the end of the piece. Hence power-loom cloth is always of a more equable and regular texture than that woven by hand.

Power-looms are generally placed in sheds, and lighted

from the top by a single range of windows to every row of looms. The weavers, or rather the tenters, have very little to do besides watching the machinery, and correcting any defects in the materials to be woven. As the labour is light, it is usually performed by women or young persons; and we were informed that the business is so simple, as to be easily learned in a month or six weeks.

The cloth, when woven, is either made up for sale in an unbleached state, or sent to the bleach-works, where, as we shall hereafter see, it goes through a series of processes, not less ingenious, and scarcely less complicated, than those which have been just described. Having noticed the several processes displayed in a cotton-mill, it remains to examine the structure of the edifice in which all this various and complicated machinery is contained. This is a subject of much greater importance than is generally supposed; for the architectural arrangements of the mill exercise very great influence, not only on the perfection of the manufacture, but also on the health and morals of the operatives. Mr. Fairbairn, of Manchester, in addition to his great eminence as an engineer, is the most distinguished authority in factory architecture, and the mills erected under his superintendence may fairly be taken as models.

The moving power may either be the steam-engine or the water-wheel, or a combination of both. There are few opportunities for the erection of water-wheels in the immediate vicinity of Manchester, and I believe that all the town mills are set in motion by steam. But in the romantic valleys and dales, north and east of the town, at a distance of from ten to thirty miles, waterfalls are brought to aid steam, and save the consumption of coals. Formerly, the steam-engine was imbedded in the structure of the building in which it was placed; so that when it was necessary to be removed, a great part of the masonry had to be taken down. Modern engines are usually constructed more like those used in steam-packets;

they are secured by bolts to the floor and walls, and can be taken away without any displacement of the structure. The boilers which supply steam are usually placed in an external shed. The engine, or engines,—for two are sometimes combined,—work by cranks and cogs, so as to set in motion the horizontal shaft to which the fly-wheel belongs. From this shaft, motion is communicated to the main upright shaft, which extends from the foundation to the upper story of the mill. This again sets in motion horizontal shafts, extending along the ceiling of each story in the building. The advantage of having two engines arises from the working of them in such a way, that the one exerts its greatest force when the other has the least, so that the joint operation of both gives an equable motion to the shafts, which being smooth, highly polished, and fixed in firm bearings of brass work, silently and evenly, without producing any of those vibrations which those who only know the working of steam-engines from the experience of a steam-packet might expect, and which I am informed, was frequently and injuriously experienced in the older factories.

Though water may not be wanting to drive a wheel, the vicinity of a river or canal is almost essential to a mill, in order to facilitate the conveyance of fuel, to supply the boilers, and to afford good drainage. Hence, most of the mills in Manchester are close either to the Irwell or the Medlock; and the noble Mersey is studded with factories for miles upon miles of its course.

Compactness is a very important consideration in the construction of a mill. It is desirable that as little time as possible should be lost in removing the cotton from the scene of one set of operations to the stage of its next process. Hence, mills are erected of seven or eight stories in height, even in those localities where the saving of ground need not be taken into consideration. The stairs are now, almost without exception, of stone; the staircase is of the kind usually called a well, that is, it winds spirally round a hollow shaft in the centre.

As communication by the stairs would in many cases be tedious and fatiguing, the centre of the well is occupied by a contrivance called the hoist, which may be briefly described as a moveable closet that can ascend or descend at pleasure through the shaft of the well, and land the persons in it on any of the floors of the mill, through doors which open from the shaft on the lobbies. This very economic and benevolent contrivance for saving the fatigue of ascending and descending stairs, was the joint invention of Messrs. W. Strutt and Frost, of Derby.

The most scrupulous attention is paid to cleanliness in almost every mill; those which were exceptions are fast disappearing. But cleanliness is found in Manchester where it would be least expected, among the firemen and attendants on the boilers. The coals are raised from their bins in a yard by a series of buckets, similar to those of the dredging machines used for deepening the beds of rivers, thence they are emptied into a traverse-wagon with a deep bottom, which moves on a railway over the feeding-hoppers attached to each furnace, and are supplied to the fires in the exact proportion required to generate steam necessary for the work.

Not only are the floors and walls kept free from the slightest impurity, but the overseers take care that the children shall keep themselves neat. They go round every morning and reprove those who have failed to wash themselves after breakfast; the delinquents are without excuse, as soap, water and towels are provided gratuitously for their use. In many mills, boxes and nests of drawers are provided, in which the female operatives deposit their street dresses, and put on their working clothes before they begin their labours. There is also a separate washing and dressing room for the women, from which as well as from their other places of retirement, the male operatives are carefully excluded. We have been much interested by observing the difference of appearance between the females when

at work, and when they are going home to dinner; they do not exhibit any trace of their occupation when they appear in the street; many of them indeed display in the arrangement of their dress and person a neatness and taste not unbecoming a higher walk of life.

The proper ventilation of the rooms is now regarded as an object of primary importance in the construction of mills. Taylor's mill, near Preston, is in this respect a perfect model; it has in every room a double system of ventilators; the series at the top of each room removing the foul air, while fresh air is supplied by those near the floor.

The mills are warmed by steam-pipes, from which some portion of the steam is permitted to escape and mix with the surrounding atmosphere. We have already noticed that a moist warm temperature is essential to the perfection of cotton manufactures, and especially to the spinning of the finer yarns; but the influence of such an atmosphere on the health of the operatives appearing questionable, we sought information from various medical gentlemen who had enjoyed long opportunities for observing the vital statistics of factories. They unanimously condemned the system of warming apartments by stoves or hot-air pipes; they declared that a dry, heated atmosphere is pernicious, and referred to the experience of the calico-printers, and of those who are in the habit of using Arnott's stoves. We subsequently found that bleachers and calico-printers have generally adopted the system of heating by steam in consequence of the ill effects produced by dry hot air on the health of the operatives.

Regularity and precision are required in all the operations of a cotton mill, and these are enforced by the accurate working of the machinery. Accidents from the machinery are of very rare occurrence; the most dangerous parts of the turning shafts, which almost alone are perilous to the incautious, are either protected by wooden boxes, or placed where there is rarely occasion

to pass them. The driving-straps are dangerous only to those who voluntarily encounter peril. Were the proprietors to leave the dangerous parts of their machinery so exposed as to produce great liability to accident, they would not only be needlessly cruel, but stupidly blind to their own interests. Any accident would produce a derangement of machinery, the repairing of which would cost infinitely more than the cases or boxes necessary to prevent its occurrence. In one mill, we were told that slight cuts and bruises were frequently occasioned by the tricks which young operatives played upon each other when employed to oil the machinery, but in most of the instances in our inquiry from the operatives respecting the frequency of accidents, they laughingly asked if we thought workpeople were such fools as to hurt themselves designedly.

Most modern mills are built fire-proof; those which are not so, have generally a fire-engine of their own, in the use of which the operatives are occasionally exercised. It is now, also, the favourite plan to have the cotton raised by a crane in its raw state to the upper story; it then descends from floor to floor in the successive stages of its manufacture, until on the ground-floor it is woven into cloth by the power-loom.

The amount of capital invested in a spinning mill is usually calculated by the number of spindles required, which not unfrequently amounts to one hundred thousand. Some years ago the cost of a mill was estimated at 1*l.* per spindle; but in consequence of the progress of mechanical improvement, the cost is not now rated higher than 13*s.* 4*d.* per spindle. The rapidity with which the great engineering houses can stock a mill with all its engines and machinery is scarcely credible; they are enabled to do so by having accurate wooden models of all the several parts, from which castings are easily taken, and the framework is thus got ready with the greatest expedition.

We have a little anticipated our subject in order to

set before our readers in one view the economy of a cotton-mill with power-loom-shed attached. We must now turn to examine some other kinds of weaving; but before doing so it will be advisable to examine a question which has engaged much of public interest and attention,—the influence of the power-loom in deteriorating the condition of the hand-loom weavers. In the course of the discussion it will be necessary to restate some principles which have been already set forward in this little work, and to direct attention to some very obvious truths, which, though trite and familiar to all who have studied the practical operation of industrial employments, are too generally neglected by many who take an active part in discussing the condition of the operatives.

Labour, like everything else that comes into the market, has its price regulated by the ratio between demand and supply. Now, if there be any species of labour requiring but a small exertion of skill and strength, the supply in that branch of industry will be mainly derived from the unskilful and the weak, whose competition will of course bring down the wages of those who may possess greater knowledge and power, but who have entered on a trade in which there is no demand for these qualities, or at least for such an amount of them as many operatives engaged in that branch of industry may be supposed to possess. In general we find, that the rate of wages in any employment is regulated by the amount paid to the lowest rate of qualifications adequate to the performance of the task. If the same piece of work can be equally well executed by an ordinary man and an ordinary child; it is far more likely that the man will be reduced to the child's wages than that the child will be raised to the man's wages. The hand-loom-weaving of plain goods is an employment which requires so low an amount of qualifications, that a number of Irish labourers, disappointed of obtaining employment in reaping the harvest, turned to the hand-loom,

and with scarcely any training were found adequate to working the machine. We have ourselves seen persons working at the hand-loom whose debility would have incapacitated them from obtaining employment in almost any other branch of industry. In the neighbourhood of Burnley and Colne, we saw children working at these looms, and it is therefore clear that such competition must have brought down the rate of wages, even if the power-loom had never been invented.

If one manufacturer employed men paying them men's wages, he would soon be driven out of the market by another manufacturer who employed children and paid only children's wages. If all the manufacturers of England combined to employ men only, it would only be a stimulus to the employers of children in the other countries of Europe and America. The home-market even now is insufficient for the absorption of the goods produced, and the foreign market must be closed as soon as foreigners are able to undersell us. In fact it would be impossible to retain possession even of the home-market, for the foreign goods if not regularly imported would assuredly be smuggled in, and the hand-loom weavers would thus only exchange insufficient support for absolute starvation.

That the fall in the rate of wages has not been caused by the competition of machinery, may be proved from a variety of considerations, each of which by itself is sufficient to establish the point, but all taken together are irresistible: in the first place, the number of hand-loom weavers is as great if not greater now than it was at any former period, thus showing that power-looms have not displaced any portion of the former demand for labour, but have in fact created a new branch of industry previously unknown; secondly, a reduction of wages has taken place in branches of weaving to which power has never been applied; and finally, the rate of wages in the various branches of weaving is strictly regulated by the amount of strength, intelligence, and training

required in these different departments of the trade. The low wages of the hand-loom weaver, therefore, do not result from his having entered into competition with machinery, but from his having entered into competition with the feeble and unintelligent of his own country, and still more from his having entered into competition with foreigners in a branch of production which receives no mechanical assistance from British skill to compensate for the burthens and disadvantages which press upon British industry.

Supposing that every power-loom in the world could be destroyed simultaneously, there is no doubt that the wages of the hand-loom weavers would be immediately raised, and just as little doubt that the rise would only be temporary and delusive. There would be an instant influx of weavers from Ireland, Scotland, and Wales; a branch of trade the demands of which can be supplied from the drainage of hospitals, workhouses, and gaols, would, in fact, be nothing better than a common sewer, clean enough when first opened, but very soon choked up by the increasing influx of the refuse from every other branch of employment.

There can be no other remedy, therefore, for the distressed of the hand-loom weavers but the extension of some cognate branches of industry in which those of superior qualifications may find employment, after they have abandoned the hand-loom to the feeble, the young, and the unintelligent. Such avenues of escape are clearly not open at a time when the leading periodical of the British Empire, the *Quarterly Review*, informs us that the great staple branches of British manufactures are in such a depressed condition as to render the late closing of the mills, and the consequent loss of the interest on the enormous amount of invested capital "at most a temporary inconvenience, and, in many cases, a great relief." When invested capital can be worked at a fair profit, new avenues of industry will be opened to such of the operatives as have the capacity to follow

them; plain hand-loom weaving will then be abandoned to the weak and feeble, who will, of course, receive only such wages as are paid to youth and weakness.

It would be impossible to give an intelligible account of the weaving of twilled, damasked, and figured patterns, without entering into a fatiguing detail of the minutiæ of complicated machinery, and employing a vast number of wood-cuts which would be scarcely explicable to any save those who have a familiar acquaintance both with the science and practice of mechanics. We shall, therefore, mention only a few of the general peculiarities which may serve to indicate the varieties in the several branches of manufacture.

Woollen cloths, which are rarely woven by power, when taken out of the loom are scoured and pulled by being subjected to the action of enormous wooden mallets, suspended by their handles, and lifted in succession by cogs fixed on the axle of a water-wheel; as the cogs escape from the raised mallets they allow their heavy heads to fall by their own weight on the piece of cloth which lies beneath them in a wooden trough. In this operation the cloth shrinks to about one half of its breadth, and it must, therefore, be woven of nearly double the width which it is intended to have when finished. On this account, previous to the invention of the picking-peg and fly-shuttle, it was usual to employ two weavers in weaving a piece of broad-cloth, who threw the shuttle from one to the other.

Fulling was a very important branch of industry amongst the Romans and constituted an incorporated trade (*collegium*). The process was performed by placing the cloths in a vat of some alkaline solution, where they were trampled by the naked legs of the fullers, whose feet thus performed the same office as the heads of the mallets in the modern fulling-mill. The curious tax imposed by Vespasian was placed on the scouring material most frequently used by the ancient fullers.

The cloth after being fulled is *tentered*, or stretched on a frame provided with iron hooks called tenters, that it may dry in the open air. After this a nap is raised on the cloth by teasels, which are a species of thistle, with very sharp and strong spikes; many contrivances, however, have been made for introducing metallic imitations of teasels instead of the vegetable thistle. We find that the ancient Romans usually raised the nap with the skin of the hedgehog. Some years ago, it was the custom to fix the teasels together in a frame not unlike the currycomb used in grooming horses, and with this the cloth was rubbed both in a wet and dry state, so as completely to raise the fibres into a nap. This operation is now usually performed in the gig-mill, which is simply a cylinder covered with natural or artificial teasels made to play against the cloth. The cloth is then sheared or cropped to render the nap even, an operation formerly performed by hand, but now executed by very beautiful machinery; it is then brushed, calendered, and pressed, which operations are repeated until the nap is perfectly smooth and level.

We have not heard of any instance in which the power-loom has been applied to the manufacture of silk goods, and we do not believe that it will ever be employed in the fabrication of the fancy patterns produced by the Jacquard looms.

No one who has visited the establishment of Mr. Lewis Schwabe, of Manchester, can ever forget the extraordinary beauty of the fabrics wrought in his Jacquard looms. The richness and beauty of the patterns surpass all that the imagination could previously have conceived: the flowers wrought into the silks and satins appear more like the work of the best painter than of the weaver. He has also some of the finest specimens yet produced, of the interweaving of glass thread with textile fabrics. But nothing in this establishment is more likely to engage the attention of a scientific visitor, than the application of the pantagraph to the art of embroidery. The

embroidery loom is an upright frame, on the top of which is a moveable rod attached to one arm of the pantagraph. The material to be embroidered passes over this rod to a roller beneath. On each side are carriages having a horizontal motion backwards and forwards, supplied with a system of clippers, and also of needles having the eye in the middle; these needles are threaded with the various coloured silks that are to be embroidered on the suspended piece. The tenter, sitting at one end, moves the long arm of the pantagraph to a point marked in a copy of the pattern, and the other arm of the pantagraph gives a corresponding motion to the rod from which the piece is suspended; one of the carriages moving forward drives its needles into the suspended cloth; they are then caught and drawn through by the clippers in the carriage at the other side; this process is repeated at every change of the pantagraph, and thus several copies are embroidered with mathematical accuracy on the piece at the same time. So simple is this very ingenious contrivance, that the frame may be worked by a woman and two girls; the woman guiding the pantagraph to the points marked on the pattern, and the girls directing the motion of the carriages.

Mr. Schwabe has several Jacquard looms at work, and in these are produced some varieties of figured satin, such as we have not seen in any other establishment. Among these, a pattern differing from the ground-work only by a shade of tint is particularly remarkable; the effect produced is that of the finest pencilling, and both in beauty of design and accuracy of execution not unworthy of the first artist.

Many circumstances contribute to determine the geographical distribution of the various branches of the cotton trade. Calico printing, for instance, is most conveniently conducted in rural districts, and in the vicinity of milk-farms; because the cloth, after receiving the mordants, must be passed through a mixture of cow-dung and water, which fixes the mordants in the cloth

better than any preparation yet discovered. Cheapness of ground is an object of great importance in weaving by machinery, on account of the large extent of the power-loom sheds. Hand-loom weaving is the branch most independent of localities, and is therefore the most widely distributed.

Fustian weaving appears to flourish most on the southern and eastern frontiers of Lancashire, from Warrington round to Oldham. It is woven both by power and hand; and there are some peculiarities in the process which merit a description. Common fustian is a coarse, thick-twilled cotton, commonly called pillow; but corduroys, velverets, velveteens, and thicksetts, belong to the same fabric, differing only in the fineness of the material, and the greater care bestowed on the superior article. In the process of twilling, the weft, instead of passing alternately under and over each thread of the warp, alternates at certain intervals, so as to bring three or more threads of the warp together, like the strands of a rope, at the determined spots, and bind them into one cord. The resulting texture is, consequently, thicker than cloth woven in the ordinary manner; but it is not necessarily much stronger, because the parts are less perfectly held together.

Ordinary cotton would be obviously too thin for outside clothing, except in tropical climates, and the process of twilling has been therefore introduced, in order to accumulate a large quantity of material in a given space. Flushing is another process, originally borrowed from silk-weaving, sometimes applied to plain, but much more usually to twilled goods. Its effects are best seen in velvets and in corduroys, which are in fact coarse striped velvets. Flushings are weft threads, which pass over certain parts of the warp without being decussated, and which, therefore, when the piece is woven, form loops on its surface. The patterns of the flushings may be almost infinitely varied by the use of extra warp or extra web, and by the introduction of different colours;

but, in most cases, they are raised by additional shots of weft. In the weaving of the plain or tabby-backed velvets and velveteens, it is usual to throw in two shots of flushing for each shot of ground. Cords, or corduroys, are always twilled fabrics, and velveteens plain.

When the piece is woven, the threads intended to form the pile are spread over the surface in a series of loops, which must be cut through with a knife. This is a very delicate operation, whether performed by hand or by machine. The cloth is spread upon a table about six feet in length, and held in a state of tension by two rollers with ratchet wheels, one of which gives out the cloth, and the other folds it up, as the cutting of each six-foot length is completed. The knife is made of steel, about two feet in length, having a square handle at one end, and tapering at the other into a blade as thin as paper; a guide is fixed at the lower side, which prevents it from turning and cutting the cloth, and at the same time checks its elasticity. The operative, holding the knife in the right hand, places the projecting point under the extreme loop of the weft, and balancing his body on the left foot, like a dancer about to execute a difficult pirouette, pushes the knife straight through the entire length of the table, and repeats the operation until every loop is cut through; the cut portion is then taken up on the receiving roller, and the operation is repeated on a similar portion, which is at the same time given out by the delivering roller. Cords, or corduroys, are generally stiffened with glue previously to their being cut.

The machine for cutting fustians reverses the operation of the hand: in it the knives are fixed, and the cloth is drawn over them. Its superiority consists in its having a series of knives, which cut all the loops simultaneously, while an operative can cut only one row at a time. The cloth is drawn up an inclined plane, on which the series of knives is fixed at a proper angle. The handle of each knife is inserted into the socket of a

circular spring connected with a transverse bar, which, by means of the levers and arms attached to it, will throw the machine out of gear when the operation of the knife is impeded by any obstruction, such as a knot in the cord. Should the knife cut through the cord, its weight will fall on a transverse bar with similar appurtenances, and the action of the machine will be immediately stopped. There is also a third contrivance of the same kind, in the possible case of the knife jumping up out of the series of loops which it is cutting. From this brief description, it is evident that the great merit of this machine consists in its security against accidents. There are few machines, indeed, which equal it in the ingenuity of the contrivances for stopping the work when anything goes wrong.

The loops being cut, the next operation is to raise the pile, and give it uniformity of appearance: for this purpose it is passed through the brushing, or teazling machine, which consists of a series of wooden rollers, covered over with tin-plate, the surface of which has been burred, or rendered rough, by a punch. Over each of these rollers there is a block of wood, the under surface of which is hollowed out into a concavity corresponding with the roller. These concaves are lined with card-brushes; and, being moved by a crank backwards and forwards in the direction of the axles of the rollers, they brush and raise the shaggy surface of the fustain as it passes over the rollers, and by their continued action render the pile uniform and smooth.

The pile, or flushing, adds not only to the warmth and beauty of the fabric, but, by its resistance to friction, greatly increases its durability. In order to perfect the smoothness of the pile, the cut surface of the cloth is singed by being passed rapidly over an iron cylinder kept red-hot. Both processes are repeated three or four times, until the surface of the cord is quite smooth and polished.

After being dyed, fustians are stiffened with glue, and

then rapidly dried by being passed over hollow cylinders kept heated by steam. Before they are ready for delivery, it is necessary that both cords and velveteens should be polished: the former are well rubbed with a bar of wood, on which coarse emery has been glued; the latter are finished by being slightly run over with bees-wax, and then polished with a wedge of hard wood.

When smooth fustians are cut before dyeing, they are called "moleskins;" but if cut after being dyed, they are named "beaverteens." There are many other varieties of this fabric; but their description would be interesting only to persons engaged in trade. Enough has been said to show how this peculiar process of weaving accomplishes the desirable results of increased warmth, durability, and susceptibility of ornament.

CHAPTER XI.

BLEACHING, DYEING, AND CALICO-PRINTING.

A VERY important process in the flax and cotton manufacture, but more especially in the latter, is Bleaching, or the removal of the colouring matter of the vegetable fibre from the woven cloth.

Bleaching, almost within the memory of man, could be effected only during the summer months, and required several weeks for its completion. It was common in the last century to send cottons and linens in the spring to be bleached on the level plains of Holland, and to receive them back late in the autumn. When cloth was bleached at home, the quantity of ground it occupied for such a length of time was very considerable; its exposed state attracted the cupidity of thieves, and the means taken for its protection multiplied capital punish-

ments, led to a dangerous extension of man-traps and spring-guns, and placed deadly weapons in the hands of unskilful and imprudent persons. The horror excited by the execution of a lad for robbing a bleach-ground, on what is said to have been rather insufficient evidence, is not yet forgotten. Sir William Meredith, in his speech against the frequency of capital punishment, gave a powerful description, which will not easily be forgotten, of the general sympathy excited by his condemnation, of the efforts made to procure a pardon, of its refusal on the ground that the robbery of bleach-grounds had become a very common crime, of the lad's agonizing protestations of innocence on the scaffold, and of the multitudinous groan of the spectators when the law fulfilled its vengeance on its victim.

Another, and if possible a darker story, is told of the ancient system. The son of an extensive bleacher went to sea at an early age; he voyaged into distant lands, and for many weary years had not set his foot on British ground. His ship at length arrived in Liverpool; he took his place on the coach, which then quitted Liverpool in the morning, and reached Manchester in the evening. His father's place was a few miles from the latter town, but he was too impatient to wait for the coming of another morning; he set out on foot, and, when he came near home, took a short cut to his paternal house through the bleach-field. There had been a robbery in the neighbourhood some time before; the lad's father was himself on the watch: he saw the supposed robber going directly to the cloth, levelled his rifle, fired, and his own son fell mortally wounded. The shot collected a crowd; the dying youth was recognised by his family;—the veil must cover the rest of the picture. We give this story as we heard it, from the mouth of an old man who said that he remembered the circumstance. It certainly is a possible occurrence; for our own memory supplies us with a parallel catastrophe in another part of the empire.

An accident led the Swedish philosopher Schele to

observe the effect of chloride, or oxymuriatic acid, in removing the colouring matter of vegetables. The French chemist Berthollet extended Schele's experiments, and in 1785 published an account of the efficacy of the new acid in bleaching vegetable fibres. Mr. Thomas Henry of Manchester, who was then rising into fame by his skill as a practical chemist, his abilities as a lecturer, and his accomplishments as a general scholar, repeated and extended the experiments of Berthollet. In 1788 he exhibited to the trade a yard of cotton cloth bleached by chemical means. The process was first extensively used by the Messrs. Ridgway of Bolton; it was gradually rendered more complete by the continued application of Dr. Henry, and by the labours of Watt, the improver of the steam-engine, and Mr. Tennant of Glasgow.

Bleaching and calico-printing are generally united in the same establishment, as a large supply of water is required for both processes. The bleaching and printing factories are therefore erected in the vicinity of Manchester, rather than in the town; but they are most numerous in the valleys between Bury, Blackburn, and Clitheroe.

When cotton cloth is brought to the bleachers, it is looked over very carefully and picked; it is then measured, and taken to be rolled evenly on a cylinder. The rolling of the cloth, both for bleaching and printing, requires great accuracy to prevent any crease; for this purpose it passes over a jointed cylinder having an eccentric motion, which smooths out the cloth by the lateral movement of the parts. The first process is singeing: the cloth passes rapidly over a red-hot copper cylinder, which burns off loose "fly," broken threads, and any other inequalities on its surface, without injuring the texture of the cloth. During this operation a very pungent smell is given out from the burning particles of cotton; but it produces no ill effect on the workmen, because they are chiefly engaged at the front of the furnace, where the smell is least sensibly observed, and

because the process is usually conducted in an open shed, through which there is a constant current of fresh air.

After having been singed, the cloth is thrown loose into water, and after some time is taken to be more effectually washed by the dash-wheel.

This is a very large hollow wheel, usually divided into four compartments, in each of which is a bundle of cloth. It is supplied with a jet of the purest spring water that can be obtained, through a circular aperture in the side; and the wheel, in order to receive this water, revolves close to the end of a flattened pipe. The flow of the water can be regulated with the greatest precision; and the ease with which it is turned off and on, is calculated to excite the attention of a visitor,—the cloth being thrown backwards and forwards by the rapid revolutions of the wheel.

The washing does not remove all the gluten and oil which the cloth received when it was subjected to the dressing process by the weaver; for this purpose it must be boiled in lime. The boiler has a false bottom perforated with holes, over which the cloth is laid in alternate layers with cream of lime. A stream of boiling water jets from a pipe in the upper part of the boiler over the layers, and sinks through them into the part below the false bottom; here, as it is again heated to the boiling point, it is forced up through a pipe in the middle of the boiler, and again spouted over the cloth. This process is usually continued for eight hours, when, the paste-dressing, grease, etc., being effectually removed, it is once more washed in the dash-wheel.

In the next process the cloth is steeped in a weak solution of sulphuric acid, which forms a sulphate of lime with the lime of the former operation. After this it goes back to the dash-wheel. It is next boiled in a weak solution of carbonate of soda, to remove any oil or grease left by the lime, and again washed by the dash-wheel.

The cloth is now ready to be subjected to the action

of the bleaching fluid, that is, chloride of lime dissolved in water. About a gallon and a half of this liquid is allowed for every pound-weight of cloth, and about one pound of bleaching powder for two pounds of cloth. In this mixture the goods are steeped for about six hours; when they are taken out, they appear sufficiently bleached to an unpractised eye, especially after they receive another washing in the dash-wheel. But the experienced eye soon discovers that the colouring matter of the fibre is not yet completely removed.

Again the cloth is steeped in a weak solution of sulphuric acid, the mixture having one gallon of acid for every twenty-five gallons of water. The chlorine disengaged during this operation would render the process unwholesome without care and vigilance, but it is conducted with such caution that all danger is averted. In this process the oxide of iron which may have been deposited on the cloth is removed, and the lime disengaged from the chlorine forms sulphate of lime with the acid. Sulphate of lime, being in fact soft alabaster, is capable of being applied to ornamental purposes; we have seen some pretty toys at Mr. Thompson's great works at Primrose, near Clitheroe, made from the sulphate which had been deposited on the sides of the vats.

After having been washed, the cloth is again boiled in a solution of carbonate of soda; then washed, and passed through a weaker bleaching fluid than was first used; washed again, and a third time passed through the solution of sulphuric acid. The bleaching process is now complete, and the cloth receives its last washing previous to its being dried.

The first steeping in sulphuric acid, and the first boiling in the ley made of carbonate of soda, in the order of our enumeration, are not invariably employed; they are, however, rarely neglected by those bleachers who prepare cotton for their own printing.

After the cloth is washed, a great part of the water is squeezed out by passing it between two rollers; in

this damp state, it is straightened and mangled. If the cloth is designed for sale without being printed, it is smoothed and stiffened by being passed through weak starch made of wheaten flour, to which some add a little porcelain clay and calcined sulphate of lime. These substances render the cloth stiffer and apparently stronger than it really is: they also improve the gloss which is imparted to it in the process of calendering. The cloth is then passed through the drying machine, which consists of several copper cylinders heated by steam.

The calender (a corruption of cylinder) consists of several cylindrical rollers which play against each other. The cloth slightly damped, passing, between these, is very tightly pressed, and its surface becomes smooth and glossy. It is sometimes made to assume a wiry appearance, by passing two pieces together through the roller, so that the warp threads of one should be impressed upon the other. After being calendered, the cloths are folded in pieces, each of which receives a distinctive mark; they are then compressed in Bramah's patent press, packed, and sent to the merchant.

The cost of bleaching is about one halfpenny per yard, and the time occupied in the process is from one to two days; but, if any object were to be gained by greater speed, the process might easily be accelerated.

Bleach-works require engines of considerable power: those who undertake their management must combine chemical with mechanical skill, for every process is effected either by chemical agents or by machinery; human hands are employed only to convey the cloth from one series of operations to another. Very large capitals are invested in bleaching establishments, and considerable sums are annually spent in chemical experiments. The mere arrangement of the vats, boilers, and machines requires extraordinary care; and the strictest method and order must be preserved in the entire establishment. The managers are always men

of science, many of them taking rank with the first chemists of the day: when printing is superadded to bleaching, the range of their acquirements must be further extended; and in fact they are, taken as a body, among the most scientific and well-informed of any class in England.

The destructive effect of chemical works on the trees and plants in their neighbourhood, is very generally known; there is an entire grove near Bolton, in which every tree has been killed by the effluvia of a chemical manufactory in the neighbourhood. But, on the other hand, we never saw a more thriving collection of water-plants than that which exists in one of the reservoirs of Mayfield; the water-lilies are particularly fine.

Having described the bleaching processes, we shall now give an account of Calico-printing, an art in which England is yet unrivalled. Calico-printing in England may be said to have been created by the rivalry of the woollen and silk manufacturers. In the year 1700 the silk and woollen manufacturers obtained an act of parliament prohibiting the introduction of the beautiful prints of India and the adjacent countries. But, instead of people returning to their old materials of dress, the taste for chintzes remained as strong as ever;—plain calicoes were imported from India, and printed in England. So rapidly did the business increase that it attracted the notice of the administration, and was, of course, made to contribute to the revenue. The woollen manufacturers were not daunted; they obtained in 1720 a law prohibiting the wear of any printed or dyed goods of which cotton formed a part, with the exceptions of blue calicoes, muslins, and fustians. Ten years afterwards this statute was so far relaxed as to allow the printing of cloths with a linen warp and a cotton weft; but it was not until 1774 that the printing of cloths manufactured wholly of cotton was legalized in England

The printing business was at first confined to London and its vicinity; but it was introduced into Lancashire

about the middle of the last century, where the local advantages of vicinity to the cotton manufacturers, cheapness of fuel, abundance of water, and a rate of wages more moderate than that of the metropolis, soon enabled it to triumph over all competition.

The success of calico-printing in Lancashire must, in a great degree, be attributed to the family of the late Sir Robert Peel. It is recorded as a curious proof of the humble means with which he commenced laying the foundation of his fortune, that, when his father began to try experiments, the cloth, instead of being calendered, was ironed by a female of the family, and that the pattern was a parsley-leaf. From this time the progress of calico-printing in Lancashire is identified with the rise of the Peel family; the establishments which they founded have for the most part passed into other hands, but they still rank among the largest in the north of England.

The oldest form of calico-printing, which is still continued for several kinds of goods, is block-printing. The pattern is carved in relief on an engraved block of sycamore, to which a handle is attached; the workman applies the surface of the block to a woollen-cloth, kept saturated with the colour, and then, placing the block on the piece to be printed, strikes it with an iron mallet, so as to leave an impress of the figure. There are wire-points at the corner of the block, which enable the printer to apply it with exactness, and to make different blocks "justify," or fall in the same place, when several are required to produce a single pattern. If there be more colours than one in the pattern, it is necessary to have a separate block for every colour, and to repeat the stamping with every block. The skill of the workman is shewn in the accuracy with which the several blocks fall into their proper places on the pattern. This is a slow and tedious operation; the printing of a single piece of calico, twenty-eight yards in length, requires the application of the block 448 times.

A nearer approach to the process of letter-press, or

rather stereotype printing, is sometimes used with great advantage in small patterns. Instead of cutting the block, the pattern is raised on it by the insertion of bits of copper, which are firmly fixed in it at a uniform height, and form in effect a stereotype plate. This invention, which some time since was applied to the printing of music, and subsequently abandoned, appears, if we may judge from its application at Mayfield, to be of great value in cotton-printing: the copper is more easily cleaned than the wood; there is less chance of blotching the pattern, and a greater facility of making several blocks "justify" with each other when it is necessary to combine them for the production of a figure with several colours. When any error was made in this respect with the ordinary process, it was necessary to destroy the block and cut a new one; in the newer process, when an alteration is requisite, the copper points are easily moved to their proper place, a pincers draws them out, and a hammer drives them in without delay or difficulty.

The use of the blocks with raised points has led to the invention of a species of press, also to be seen at Mayfield, which prints several colours at once. The cloth to be printed unrols only the breadth of a single colour-block at a time; as it passes successively under the blocks, which are placed in close contact, it receives of course a separate impression from each, and is given out from the press with all the colours of the pattern complete. This invention, it is believed, is capable of being extended and improved, and we have heard of attempts made to apply it to letter-press printing.

As delicate patterns could not be easily engraved on wood, copper-plates were introduced—chiefly, we believe, in the neighbourhood of London—and they were applied by means of the ordinary copper-plate press. This was the most tedious of all the processes employed, and the goods thus produced were consequently very dear; it is now, we believe, almost wholly disused.

Cylinder-printing is far the most important improve-

ment made in this art, bearing nearly the same relation to block and plate-printing that the mule does to the old spinning-wheels. It is said to have been invented by a Scotchman named Bell, and was first applied to printing in Lancashire about the year 1785. The patterns are engraved on a polished copper cylinder, round the whole circumference, and from one end to the other; the diameter of the cylinder is about three inches, and its length varies according to the breadth of the cloth to be printed. The cylinder revolves horizontally in a press, the lower part turning over a trough containing the colouring matter, which it of course takes up; an elastic knife-blade working against the cylinder, something like the crank and comb in the carding-machine, removes the colour from the smooth surface of the cylinder, leaving only the portions contained in the engraved lines of the pattern. The piece of cloth being passed over, and pressed against the upper surface of the cylinder, takes up the pattern; and then, as fast as printed, it is turned over several cylindrical boxes heated by steam, which remove from it every particle of moisture.

The most ingenious, and at the same time the most simple contrivance, in this beautiful and most wondrous piece of mechanism, is the knife-blade, which is technically called "the doctor." It is said to have obtained its name from the following circumstance. When Mr. Hargreaves, a partner in the factory of Mosney near Preston, where cylindrical printing was first introduced, was making some experiments with the process, one of his workmen, who stood by, said, "All this is very well, sir; but how will you remove the superfluous colour from the surface of the cylinder?" Mr. Hargreaves took up a common knife, which was near, and, placing it horizontally against the revolving cylinder, at once shewed its action in removing the colour; asking the operative, "What do you say to this?" After a moment's pause of surprise and pleasure, the man replied, "Oh, sir, you have doctored it!"—a common phrase for

"you have cured it;" and the contrivance has ever since retained the name of "doctor."

Cylinders, like blocks, may be engraved with different portions of the same pattern, and made to justify with each other; and, as each cylinder revolves in a trough of a different colour, the resulting pattern will have as many colours as there are cylinders. It is not uncommon to see from three to six cylinders in one press, each cylinder engraved with a different part of the pattern, and printing a different colour on the cloth. A man and boy, at such a press, can do more work than a hundred men, attended by a hundred boys, could by block printing.

The preparation of patterns is an increasing branch of industry, but does not yet hold so high a rank as might be expected in England. It is not easy to estimate the cost of a design; some are purchased for a few shillings, and others bring as high a price as twenty pounds. Mr. Thomson of Clitheroe has stated in his evidence before the House of Commons, that he would have sought designs for furniture cotton from some of the most eminent artists in Europe, at an unlimited price, if he could have obtained such an extension of copyright as would secure him adequate remuneration.

A curious anecdote will shew the great importance of a new and successful pattern. Messrs. Simpson and Co. of Fox-hill Bank had to print a quantity of cloth in parallel stripes; by some accident a portion of the cloth was creased, and the stripes being thrown angularly on each other, produced a new effect, which received the name of the Diorama pattern. Such a favourite was this novelty, that the unprecedented number of 25,000 pieces was sold in one day. Novelty of effect, however, was its only recommendation, and it is now little valued.

There are two classes of production in calico-printing which differ considerably in their application and generally in their design, though some styles are common to both; these are "garment printing" and "furniture

printing." It is difficult to draw a precise line between these two branches: for some patterns are applied both to garments and furniture in Great Britain; and some patterns, which are exclusively applied to furniture at home, are exported for dresses to foreign markets. Some of the richly flowered and gaudy patterns, for instance, meet with a ready sale on the coast of Africa. In general, it may be stated, that the patterns for furniture are more elaborate and expensive than those for dress. We have seen some which, for the mere drawing and engraving, cost from fifty to a hundred pounds. A still greater expense is incurred in what is called the "making-out" of the pattern; that is, reducing it to such a scale, and making such a distribution of its parts, as will make the several portions "justify" or harmonize with each other when engraved on separate blocks or cylinders. Patterns have been exhibited which had to be drawn over again five or six times, because the least imperfection in furniture designs is at once detected even by an unpractised eye.

The patterns were originally engraved on the copper cylinder by the hand; they are now transferred to it by mechanical pressure from a small steel cylinder, similar in principle to the invention which Mr. Perkins devised for multiplying the plates of bank-notes. It is generally difficult to determine the claims of a disputed invention: it is, however, certain that Mr. Joseph Lockett of Manchester practised this process in 1808, before Mr. Perkins had come from America to settle in London; and he brought it, almost unaided, to the very high degree of perfection which it has now attained. The pattern, having been drawn so as to fit the circumference of the copper, is engraved on a cylinder of softened steel about four inches in length and one in diameter. The steel is then tempered, and pressed against a second cylinder of softened steel, to which of course the lines of the pattern are transferred in relief. This again is tempered or harden-

ed; after which it is applied to the copper cylinder, on which it impresses even the most delicate lines of the pattern as finely and accurately as if they had been cut by the graver.

Another process is frequently employed, which may be called "etching."—The copper cylinder is covered with a thin coat of varnish, such as is used in the ordinary etching, and on this the pattern is drawn with a diamond-pointed tracer. The cylinder is then immersed in aquafortis, and of course the parts from which the varnish has been removed by the tracer, are corroded or engraved. The most wondrous part remains to be told; the diamond tracer is generally applied by a process similar to the eccentric chuck of a lathe, and thus the entire surface of the cylinder is covered with patterns, or ground-works of patterns, without any exercise of human skill or ingenuity.

The eccentric designs, as the patterns thus produced are called, from the eccentric chuck employed in the process, admit of incalculable varieties of form, and some of them are exquisitely beautiful. Nothing in machinery is more calculated to impress a visitor with feelings of wonder and admiration than a visit to the manufactory of the Messrs. Lockett: the patterns produced by the eccentrics appear to rival the finished labours of an accomplished artist; while the apparent simplicity of the means is so disproportionate to the complicated results produced, that a stranger is almost tempted to doubt the evidence of his senses.

When the cylinders are thus covered with ground-work, an additional pattern may be engraved upon them either by the hand or the steel cylinder. In consequence of these obvious advantages, cylinders eccentrically engraved are largely exported from Manchester both to the Continent and North America. The Prussians and Germans send their own designs to be engraved on the cylinders, having previously selected the ground-work;

but very frequently the rollers are exported, simply with the eccentric ground, and the foreign manufacturer superadds the pattern according to his fancy.

The principle of the electrotype, discovered by Mr. Spencer of Liverpool, has been recently applied with great success by the Messrs. Lockett to the engraving of copper cylinders. As this process will enable artists to transfer very elaborate designs to the copper at a trifling expense, it will probably lead to a great improvement in the art of design, which has retrograded rather than advanced in England. When the printing trade was confined to the vicinity of London, pattern-drawing flourished. Mr. Thomson of Clitheroe says, "The designs of several distinguished artists are still remembered with admiration; and Raymond, Kilburn, Wagner, and Edwards are regarded as the old masters of the English school of design in calico-printing. I have the good fortune to possess a volume of drawings of this period, in which pattern-drawing is elevated to the dignity of a fine art. The art of printing since that period has made gigantic strides, and is now one of the most beautiful and refined of the chemical arts. The art of designing has at the same time retrograded." We must however add, that, within the last two years, attention has been paid to the preparation of patterns, particularly those for mousselines-de-laine and Chinè silks; and, no doubt, English calico-printing will soon exhibit the most happy combination of the fine with the useful arts.

Having described the machinery used in calico-printing, we must endeavour to give a general notion of the process, and for this purpose we must warn the reader that the foundation of the whole may be said to be the proper application of *mordants*. The nature of these is admirably explained by Dr. Thomson in the article on dyeing in the last edition of the "Encyclopædia Britannica." "The term *mordant* is applied by dyers to certain substances with which the cloth to be dyed must be impregnated; otherwise the colouring matter

would not adhere to the cloth, but would be removed by washing. Thus the red colour given to cotton by madder would not be fixed, unless the cloth were previously steeped in a solution of salt of alumina. It has been ascertained that the cloth has the property of decomposing the salt of alumina, and of combining with, and of retaining, a portion of alumina. The red colouring principle of the madder has an affinity for this alumina, and combines with it. The consequence is, that, the alumina being firmly retained by the cloth, and the colouring matter by the alumina, the dye becomes fast, or cannot be removed by washing the cloth with water, even by the assistance of soap; though simple water is sufficient to remove the red colouring matter from the cloth, unless the alum mordant has been previously applied. The term *mordant* (from the Latin word *mordere*, to bite) was applied to these substances by the French writers on dyeing, from a notion entertained by them that the action of the mordants was mechanical; that they were of a corrosive or biting nature, and served merely to open pores in the fibres of the cloth, into which the colouring matter might insinuate itself. And after the inaccuracy of this notion was discovered, and the real use of mordants ascertained, the term was still continued as sufficiently appropriate, or rather as a proper name, without any allusion to its original signification. The term *mordant*, however, is not limited to those substances merely which serve like alumina to fix the colours: it is applied also to certain substances which have the property of altering the shade of colour, or brightening the colour, as it is called."

Most commonly the printing process is employed for fixing the mordants on the cloth, which is then dyed in the ordinary way. When the cloth is washed, those parts only retain the colour which have imbibed the mordant, and the other parts remain white. It is generally believed that this process was discovered in India, where it was undoubtedly practised at a very early

period; but, from the description given by Pliny,* it is evident that, in the first century of the Christian era, calico-printing was understood and practised in Egypt.

The most common mordant is the aluminate, formed by the mixture of three parts of acetate of lead (vulgarly called "sugar of lead") with four of alum. When this is applied by the block or cylinder, it is usually thickened with starch or gum, according to the nature and style of the cloth. In some cases the mordants formed from the chloride of tin are mixed with the colouring matter, and both applied to the cloth together; but the colours thus produced, though originally very beautiful, soon fade when exposed to the action of light and air.

The mordants, as we have said, are employed to combine with the dyes, and thus produce a permanent colour; but this effect would not follow if the entire mordant entered into a perfect chemical combination with the dye: it is necessary that a portion of the mordant should be held suspended and undecomposed in the cloth. This is effected by a process called "dunging:" the cloth tinged with the mordant is passed through a mixture of cow-dung and water, which has the property of holding the aluminates in suspense. Such, at least, is the explanation of the process most commonly given by chemists; but we have not seen any satisfactory reason assigned for the failure of the various attempts that have been made to produce the same result by a more direct chemical process.

* There exists in Egypt a wondrous method of dyeing. The white cloth is stained in various places, not with dye-stuffs, but with substances which have naturally the property of absorbing (fixing) colours. These applications are not visible on the cloth; but, when the pieces are dipped into a hot cauldron containing the dye, they are in an instant after drawn out, dyed. The remarkable circumstance is, that, though there be only one dye in the cauldron, yet different colours appear on the cloth, nor can the colours be afterwards removed.—*Natural History*, book xxxv.

The use of the dung-bath was probably first suggested to calico-printers by their observing that animal fibres, such as silk and wool, received dyes more perfectly than vegetable fibres, such as flax and cotton; they therefore sought out means to *animalize* the vegetable fibre, and the success of their experiments induced them to persevere in the practice. Many have supposed that it was some peculiarity in this process which rendered the colours of the Indian chintzes so superior to any produced in Europe; but, on inquiry from persons intimately acquainted with the manufactures of Hindostan, we have not been able to discover any plausible ground for such a supposition.

It would be impossible within our limits to give even an outline of the different chemical combinations by which colour is produced; in fact, the chemistry of dyes is now recognised as a separate branch of science, and has been the subject of many large and elaborate treatises. We shall only mention a few processes, which can be described with sufficient generality to render them interesting to unscientific readers. From what we have said, it is clear that the use of the mordants is to fix the colours of the pattern. If then the whole ground be coloured, the cloth must be immersed in the mordant, and the white must be produced by something which will neutralize or counteract its efficacy.

This counteraction of the mordants is produced by what are called "dischargers;" that is, by printing the parts designed to be kept white with an acid which will neutralize or destroy the mordant, and consequently the colour which the cloth in that place had imbibed. The citric acid is chiefly used for this purpose; and, according to circumstances, it is either applied before the cloth is dipped into the mordant, so as to prevent its action, or it is applied afterwards, to counteract its agency. This reverse of the original process of calico-printing is said to have been first intro-

duced in Scotland, but it was not practised successfully and extensively until it was adopted by the Peels of Church, about the commencement of the present century.

"Resisters," or "resist pastes," are scarcely of less value than "dischargers" in all the variety of dyes which indigo is employed to produce. While "Mordants" fix colours and "Dischargers" remove them, "Resisters" prevent the indigo dye from leaving a trace of its presence. This process is said to have been discovered by a commercial traveller, who had so little knowledge of its value that he sold his secret for five pounds. The process was first extensively employed by the late Sir Robert Peel in his works near Bury; and the beauty of its effects, and the extreme precision of outline in the patterns produced, at once placed his establishment at the head of all the factories for calico-printing in the country.

No part of the chemistry of calico-printing is more interesting than the process of dyeing Turkey-reds; but it is unfortunately very complicated, and in many of its parts apparently tentative. On one operation of a series, and one of the longest and most complicated series that exists in the whole range of the art, depends the perfect or imperfect success of the entire work. At which stage of the series this decisive effect is produced has yet eluded the investigations of science. At one time it was attributed to the effect of climate, and the air and water of Elberfield were assigned as the cause of the superiority which Elberfield attained. But Mr. Steiner, the proprietor of the great establishment at Church, one of the original manufactories of the Peels, produces the most brilliant dye without any exposure to the sun and air. This dye was restricted to yarn, until M. Koechlin, of Mulhausen in Alsace, applied it to cloth in the year 1810, and soon after discovered the means by which patterns could be printed on this beautiful ground. The process is simply to print a

pattern on the Turkey-red, or any other dyed colour, with a powerful acid, and then to immerse the cloth in a solution of chloride of lime. Neither of these agents separately would discharge the colour; but the chloride, being liberated in the parts which have received the acids, performs its usual bleaching functions, and renders the parts so affected purely white.

The various applications of manganese and the chromic dyes have given to English colours a richness and variety which bid fair to establish as great a superiority in colours as we have hitherto had in yarns and cloths. It is a fact which ought not to be forgotten, that many of the greatest discoveries in modern chemistry have been derived from experiments for the improvement of colours, and that the leading calico-printers spare neither time, trouble, nor expense in their endeavours still further to promote the science. The laboratories and scientific libraries attached to most of the printing-factories are fully equal to those of our best public institutions, and among the chemists they employ are to be found names that have shed the brightest lustre on the annals of modern science.

We have given merely a general outline of calico-printing; it is a business which, to be well and successfully carried out, requires a combination of the highest mechanical attainments, the most extensive chemical knowledge, and no small acquaintance with the art of design. Some of the print-works employ more than a thousand operatives; they are all conducted with extreme order, cleanliness, and punctuality; they exhibit at once the greatest triumphs of mechanical art and chemical science, both kept under the controul of human agency, and working for the advancement of human comfort.

CHAPTER XII.

THE FACTORY SYSTEM.

THE operations described in the preceding chapter are conducted in Factories or Mills, which may be defined "buildings in which machines of great power are at work to facilitate and abridge human labour. The first great error vulgarly committed respecting factories, is the supposition, that the abridgement of physical labour is in any way identical with diminution of employment: wherever there is any use made of mechanical contrivance, a necessity is created for mental superintendence; a demand is produced for intelligence rather than for physical strength, and, consequently, employment is varied, but not diminished. It is an undeniable fact, that the number of persons employed in the cotton-manufacture has been increased in the exact proportion that machinery has been improved, and that the general rate of wages, on an average of years, has increased, while the cost of production has been diminished.

A question often asked by the ignorant and unthinking deserves some portion of our consideration; they ask whether the demand for labour would not be greatly increased if the operations of machinery were suspended and hand-labour employed to produce the present amount of fabrics. The plain answer is, that in such a case nothing like the same amount of fabrics would be produced in England, for their price would not remunerate the manufacturer, even though he should pay his workmen the lowest possible rate of wages. The English hand-spinners of cotton could never compete with Hindoos in the production of fine yarn; with the

Egyptian Fellahs in the manufacture of coarse threads; with the African negroes in common products of the loom; or with the Indians of North America in cheap articles of dress. English artizans would starve on the same rate of wages, which would support life in a country less heavily taxed, and no higher rate of wages could they obtain so long as there existed one foreign competitor to meet them in the market. It is a great, but a neglected truth, that machinery sustains wages; for it is by means of machinery that so large an amount of spun and woven fabrics is produced; it is in consequence of the magnitude of this amount that British manufactures can be sold so cheap; and it is in consequence of their superior cheapness that these articles find purchasers. The sad example of the hand-loom weavers, to which we have already referred, shows the utter inability of British artizans to sustain competition with the foreigners when they are not backed by the support of machinery.

It is then clear, that the prosperity of British manufacturers depends on the continued concentration of mechanical power in mills and factories, by which British operatives are enabled to compete with those who, like the Hindoos, possessing a more delicate organization, could with the unaided fingers produce a finer texture; and still more to meet those in the market who, from a cheaper and more extensive command of the necessaries of life, can afford to work at a lower rate of wages, and, therefore, enable employers to bring goods into the market with less cost of production, and, consequently, with ability to sell at a cheaper rate. Thus viewed, the factory system, under the present circumstances of society, obviously affords the only means by which British industry can sustain foreign competition; but there are some other points of view in which it ought to be regarded; particularly at the present moment, when discussions have been raised on the propriety of permitting its existence.

The Factory system is a modern creation; history throws no light on its nature, for it has scarcely begun to recognise its existence; the philosophy of the schools supplies very imperfect help for estimating its results, because an innovating power of such immense force could never have been anticipated. The steam-engine had no precedent, the spinning-jenny is without ancestry, the mule and the power-loom entered on no prepared heritage: they sprang into sudden existence like Minerva from the brain of Jupiter, passing so rapidly through their stage of infancy, that they had taken their position in the world and firmly established themselves before there was time to prepare a place for their reception. These potent novelties also made their appearance in a land already crowded with institutions: the force and rapidity with which they developed themselves dislocated all the existing machinery of society, disturbed its very framework, and must necessarily produce, as they have produced, a considerable amount of confusion and suffering until the difficult task of re-adjustment is completed. A giant forcing his way into a densely-wedged crowd extends pain and disturbance to its remotest extremity: the individuals he pushes aside push others in their turn, though none know the cause of pressure save those with whom the intruder is immediately in contact; and thus also the factory system causes its presence to be felt in districts where no manufactures are established: all classes are pressed to make room for the stranger, and all are interested in knowing something of what is thus forced upon their acquaintance. Antecedent to any inquiry it would be well to recognise the factory system as what statesmen call *un fait accompli*; it exists, and must continue to exist; it is not practicable, even if it were desirable, to get rid of it; millions of human beings depend upon the factories for their daily bread,—were their heads sufficiently bold and hearts sufficiently hard to propose their extermination, where are the hands by which the sanguinary decree could be executed?

It would be absurd to speak of factories as mere abstractions, and consider them apart from the manufacturing population. That population is a stern reality, and cannot be neglected with impunity. As a stranger passes through the masses of human beings which have been accumulated round the mills and print-works in Manchester and the neighbouring towns, he cannot contemplate these "crowded hives" without feelings of anxiety and apprehension almost amounting to dismay. The population, like the system to which it belongs, is NEW; but it is hourly increasing in breadth and strength. It is an aggregate of masses, our conceptions of which clothe themselves in terms that express something portentous and fearful. We speak not of them indeed as of sudden convulsions, tempestuous seas, or furious hurricanes, but as of the slow rising and gradual swelling of an ocean which must, at some future and no distant time, bear all the elements of society aloft upon its bosom, and float them—Heaven knows whither. There are mighty energies slumbering in those masses. Had our ancestors witnessed the assemblage of such a multitude as is poured forth every evening from the mills of Union-street, magistrates would have assembled, special constables would have boen sworn, the riot act read, the military called out, and most probably some fatal collision would have taken place. The crowd now scarcely attracts the notice of a passing policeman, but it is, nevertheless, a crowd, and therefore susceptible of the passions which may animate a multitude.

The most striking phenomenon of the factory-system is, the amount of population which it has suddenly accumulated on certain points. There has been long a continuous influx of operatives into the manufacturing districts from other parts of Britain; these men have very speedily laid aside all their old habits and associations, to assume those of the mass in which they are mingled. The manufacturing population is not new in its formation alone; it is new in its habits of thought

and action, which have been formed by the circumstances of its condition, with little instruction, and less guidance, from external sources. It may be matter of question whether the circumstances surrounding the manufacturing labourer are better or worse than those belonging to the agricultural condition; but there can be no doubt that the former are preferred by the operative. In the present severe pressure of commercial distress there are scores, and probably hundreds, of workmen whom the authorities would gladly send back to their parishes if they could bring them legally under the designation of paupers; but these men submit to the pressure of hunger, and all its attendant sufferings, with an iron endurance which nothing can bend, rather than be carried back to an agricultural district. However severe the condition of the manufacturing operative may be, there is a something behind which he dreads more: he clings to his new state with desperate fidelity, and faces famine rather than return to the farm. The factory-system is, therefore, preferred to the more usual conditions of labour by the population which it employs, and this at once insures its permanence as a formative element of society, and at the same time renders its influence directly efficacious on character.*

The factory-system is about seventy years old;—a very respectable age in individual life, but a mere point of time in the duration of a system. The period of its childhood was passed while the nation was engaged in a most onerous and expensive war, during which the accumulations and savings of British industry were poured forth with a lavish hand on objects from which the British artizan derived a very feeble and indirect benefit. The earnings of the youth of the factory system were lavished in war, and no small portion of its earnings, in its more mature age must be diverted to pay the debt incurred during these wars. Furthermore, one of these wars—

* Notes of a Tour in Lancashire

that with the United States, arising out of the Orders in Council—was virtually as much a war against British manufactures as against the objects of declared hostility.

"It was the misfortune of the factory-system," says an able writer in the Athenæum, "that it took its sudden start at a moment when the entire energies of the British legislature were preoccupied with the emergencies of the French revolution. The foundations on which it reposes were laid in obscurity, and its early combinations developed without attracting the notice of statesmen or philosophers; and the concomitant development of national wealth having been unfortunately made subservient to the wasteful necessities of war, and its results consumed, the natural connexions of the labour-market were disturbed in a way that added very materially to the difficulties of a new and untried phasis of social life. There thus crept into unnoticed existence a closely condensed population, under modifying influences the least understood, for whose education, religious wants, legislative and municipal protection, no care was taken, and for whose physical necessities the more forethought was requisite, from the very rapidity with which men were attracted to these new centres. To such causes may be referred the incivilization and immorality of the overcrowded manufacturing towns, and some part of the still more fearful miseries of fluctuating markets and unsteady prices. Whatever may be thought of the oppressive weight of the interest to be paid to the national creditor, commerce has suffered far more severely by the want of the capital it represents, and which was utterly destroyed in 'just and necessary' warfare. From this consideration, something more than a *primâ facie* suspicion arises, that the imputed evils of a manufacture are foreign to it, as a cause—that they are an episode (a dismal episode) in its history, and (to use a trivial expression) much more its misfortune than its fault."

In looking at the defects at present incident to the factory system, and particularly to the insufficiency of

the provision made for the physical comfort, moral improvement, intellectual elevation, and religious instruction of the operatives, it is but fair to make very large and liberal abatement for the immense amount abstracted from the funds which would have amply provided for all these purposes, by the immense proportion of war taxation which was imposed on manufactures and the manufacturing population. It has, indeed, been said, that the stoppage of manufactures on the continent during the war, and the consequent monopoly which British manufactures obtained in foreign markets, furnished something like an equivalent for this taxation. The utter insufficiency of such a set-off will be at once manifest by comparing the average export of British goods during any ten years of the war, with the average of any ten years since the re-establishment of peace. In fact, the war was doubly injurious to manufacturers; it at once diminished production, and increased the burdens imposed on the producers. It would be a very difficult matter to calculate the amount of profits, and consequently of capital, which is but the accumulation of capital, that has been abstracted from British manufacture by direct or indirect war-taxation, and also by the protection granted at the expense of the manufacturing body to favoured classes. A mere approximation to the amount would present most astounding results; and we must not, therefore, be astonished at meeting some social evils in the manufacturing districts, when the funds which would have more than purchased remedies for these evils ten times over have been abstracted, and as utterly destroyed for all purposes of manufacturing improvement, as if they had been wantonly flung into the depths of ocean. It would be unjust for the nation after having consumed these funds to turn round and blame the manufacturers for the evils which this very abstraction of capital alone has produced.

Taking, for example, the evil of infant labour, on

which so much has been said and sung. Every man acquainted with the political history of the last half century must know, that the labour of children was actually pointed out to the manufacturers by Mr. William Pitt, as a new resource by which they might be enabled to bear the additional load of taxation which the necessities of the state compelled him to impose. The necessity for labour created by this taxation has not yet abated; because, as we have already stated, the immense capital taken away has not been replaced. But even independent of these considerations, and irrespective of a past which can never be recalled, we mean to assert, as we have done elsewhere, in broad terms and the plainest language, that the infant labour, as it is erroneously called, or the juvenile labour, as it should be called, in factories, is in fact a national blessing, and absolutely necessary for the support of the manifold fiscal burthens which have been placed upon the industry of this country. It is quite sufficient to say that the children of the operatives have mouths, and must be fed; they have limbs, and must be clothed; they have minds, which ought to be instructed; and they have passions, which must be controlled. Now, if the parents are unable to provide these requisites—and their inability to do so is just as notorious as their existence—it becomes absolutely necessary that the children should aid in obtaining them for themselves. To abolish juvenile labour is plainly nothing else than to abolish juvenile means of support; and to confine it within very narrow limits is just to subtract a dinner or a supper from the unhappy objects of mistaken benevolence.

To talk of infant labour is sheer nonsense, and nothing else. What master would be insane enough to employ an infant or a child incapable of performing the task for which he pays wages? If mill-owners and capitalists were worse tyrants than Nero, still they would not be such fools as to throw away their money

for the mere indulgence of sportive cruelty. There can be no question about the labour of infants, but there must be many questions about the labour of boys and girls, so long as operatives have families and feel the necessity of supporting them. That legislative protection should be extended to the children nobody means to deny; but the protection is wanting, not against their omployers, but against the extremes to which griping poverty in most instances, and grasping avarice in some, may drive their parents.

It has pleased some people to portray the mill-owners as the living representatives of the ogres and giants of our nursery tales, They are simply men, not one whit better or worse than their neighbours; their chief characteristic is a very acute sense of their own interests, and those interests forbid them to be tyrants. "Tread on a worm," says the old proverb, "and it will turn:" but tread on a Lancashire operative, or his children either, and you will find yourself more awkwardly situated than if you had provoked the hostility of all the worms in existence. The extremity is not likely to be tried by those who have millions of property at the mercy of a rusty nail or the ashes of a tobacco-pipe. Besides, if it were true that cruelties are practised on children in the mills, or that tasks are imposed upon them injurious to health or life, such a fact would only prove that the physical or moral destitution of the parents must be of the most frightful kind, or else they would never, for the sake of trifling wages, expose their offspring to such sufferings.

But we are gravely told, that "juvenile labour, under all circumstances, is a grievance." Let us grant it—there is one still worse, and that is juvenile starvation. We have seen, with some pain, the little piecers and cleaners employed in their monotonous routine, when the sun was high in heaven, when the skies looked smilingly upon the earth, and earth answered with its own smile of loveliness and fertility; I thought how much more

delightful would have been the gambol of the free limbs on the hill-side, the inhaling of the fresh breeze, the sight of the green mead, with its spangles of buttercups and daisies, the song of the bird, and the humming of the bee! But we have seen other sights: we have seen children perishing from sheer hunger in the mud-hovel, or in the ditch by the way-side, where a few sods and withered boughs had formed a hut, compared with which a wigwam were a palace. We have seen the juvenile mendicant, and the juvenile vagrant, with famine in their cheeks and despair in their hearts. We have seen the juvenile delinquent, his conscience seared by misery, his moral nature destroyed by suffering, his intellectual powers trained to perversity by the irresistible force of the circumstances that surrounded him. It is a sad confession to make, but owing, perhaps, to some peculiar obliquity of intellect or hardness of heart, — we would rather see boys and girls earning the means of support in the mill than starving by the road-side, shivering on the pavement, or even conveyed in an omnibus to Bridewell.

Juvenile labour is, in fact, a mere question of meat drink, and clothing. If the sentimentalists who have raised an outcry against it as a grievance, can show how the children are to be supported without their earnings in the factories, the operatives will gladly keep them at home, and thank them into the bargain; but if they have no better remedy to propose than sheer starvation, common sense will reject their interference as a mockery and an insult.

The question must also be regarded in another point of view. The operative has, as we have said, a very limited supply of domestic accommodations; and if his children were excluded from the mills, it is not quite clear what would become of them. Their homes could not contain them, even if they were disposed to remain in them — their only resource would be the street, with all its perils, and all its temptations. Juvenile labour

may be a very bad thing; but juvenile vagrancy and juvenile delinquency are infinitely worse. The children will not starve if they can help it; and if food is not to be procured by work, they must either beg or steal.

The tasks which children are employed to perform in the factories are not laborious; they are, however, for the most part monotonous and fatiguing, and the regulations which insure to them proper portions of time for recreation and instruction are certainly necessary for the preservation of their physical health, and also for the maintenance of that mental and moral power, which depends more upon the bodily constitution than is generally known; but it is my duty to declare, that the children in the mill are better off than nine-tenths of the same class throughout England. The mill is a better place than the mine, the ship, the forge, and very many private workshops. We have conversed with several young piecener and tenters who have tried both, and found that they invariably preferred the mill to the farm or the field; and, as we have lived long enough in the country to appreciate the value of Arcadian pictures of rural life, we were not astonished at their choice. It is true, that husbandry affords many occupations more healthful than factory labour, but it also has some that are worse; and, moreover, the employment it affords is not steady, and when there is no work, the comforts which work purchases must likewise disappear.

Some of the operatives, and many people of much higher pretensions, object to juvenile labour, because they believe that it diminishes the demand for the labour of full-grown people. They imagine, that if the boys and girls were withdrawn from the mills, there would necessarily be an increased demand for men and women, that employment would be more abundant, and that wages would consequently rise.

We have shown the fallacy of this expectation in remarks already made on the condition of the hand-loom weavers,—the system of juvenile labour is actually

beneficial to the operatives taken as a class. The three elements for which an employer pays are time, skill, and strength; the labourer who exerts only the skill and strength of a child will, in the long run, even leaving out of view the competition of foreign nations, obtain only the wages of a child, because he has nothing on which to rely for obtaining his value in the market. Were the manufacturers compelled to dismiss the children, they would not supply their places with trained and skilled workmen, because the training and skill would be worthless; but they would import an abundant supply of untrained labourers from Wales, from Scotland, and from Ireland, to whom the wages of the children, small as they are, would be a desirable object. Many of these would in time begin to compete with the superior operatives; they would draw them down faster than they would raise themselves up, and the rate of wages would sink rapidly below its present level. The example of the hand-loom weavers should teach the spinners the danger of a trade being inundated by operatives who require little or no preparatory training to make a commencement. It is their good fortune that the employments in the mill, which require but little skill, also demand but little strength, for it has saved them from being reduced to the level of agricultural labourers by the appearance of untrained hordes mingling in their ranks.

If it is true that everybody, old and young, is overworked in the manufacturing districts, there must be some cause for industry not being able to retain such a surplus of its earnings as would purchase the requisite relaxation. The capital absorbed from manufacturing industry during the war would have provided ample means of domestic accommodation, innocent enjoyment, and mental improvement. It would have built sufficient churches, and endowed an ample number of religious instructors; it would have supplied schools for the young, and retreats for the old; and the strongest possible proof that

such would have been the result is, that British industry when relieved from the pressure of war taxation, not only commenced, but actually made astounding progress in accomplishing, these mighty objects of social improvement, until its progress was checked by the unparalleled severity of the late commercial crisis.

But for the wondrous development of national resources opened by the progress of British skill and industry, especially in the manufacture of textile fabrics, this country could never have borne the enormons expenditure of the French war. To the same source we must look for the means of liquidating the debt incurred during these expensive hostilities, and still more for the accumulation of the means by which the physical, moral, and intellectual condition of the labouring classes are to be elevated, and the concentration of British skill and industry in factories rendered a blessing to the entire community.

The factory system has already effected great social and moral good; it has increased the value of property for every class of men existing in this country, and it has particularly enhanced the value of land. It is scarcely an exaggeration to say, that many of the best-cultivated and most profitable lands in England have been ploughed by the spindle, and tilled by the loom! It is to the industry of the cotton-spinners and weavers, which created a demand for farming produce, and opened a convenient market for agricultural articles of consumption, that we must attribute a change which has no parallel,—indeed, nothing in Europe that can at all approximate in the way of comparison—the amazing increase of the value of property in Lancashire, amounting to 6300 per cent. in 150 years. And it is evidenced by the marked disparity in the progressive improvement of places which border closely upon each other, and possess nearly the same natural advantages. This disparity was ably explained by Mr. Henry Ashworth, in a statistical paper read at the late meeting of the British Association

in Manchester. He says, in reference to a table exhibiting rates of increase, varying from more than 50,000 to less than 2000 per cent., "The only solution which can be given is, that in those places where the genius, enterprise, and industry of the people have been developed, and have had to encounter no sort of local hindrances, the prosperity of the district has proceeded with a steady onward course; whilst, in those other places which have not progressed with equal rapidity, there must have been an absence of native enterprise; a want of mines, roads, or canals; or a disinclination somewhere, perhaps on the part of the owners, to allow the natural advantages of the country to be turned to the best account.

"It has followed, nevertheless, that advantages have accrued to those localities where manufacturing industry has met with little or no encouragement; but such advantages have chiefly been derived to the land from the improved market furnished by an adjacent population for the productions of the soil. In this way manufacturing industry has not only raised the prosperity of the places in which it was developed, but has extended its benefits to all the farming localities of the neighbourhood; raising the rental of *mere* LAND, in some cases 1500, and in others as much as 3000 per cent."

Such results produced by the industry of those employed in textile fabrics, should not only inspire us with pride in the past, but with confidence in the future. And it is because we believe that the history of the textile manufactures is replete with lessons of the deepest interest, and fraught with instruction of the greatest advantage to the nation at large, that we have endeavoured to place it in a succinct and compact form before our fellow-countrymen.

THE END.

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